The Story of INSULATION BOARD

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INSULATION BOARD for HOME BUILDING

Insulation Board, an Improved Material for Home Building

INSULATION board is essentially manufactured insulating "lumber" produced in large units without knots or grain. It is classified in Federal Specification LLL-F-321a as "Fiber-board; insulating" and described as being "manufactured from wood or other vegetable fiber, by a felting process, suitable sizing material being incorporated in the product to render it water resistant."

The insulation board industry had its inception in Minnesota about 25 years ago and has grown steadily since that time until today it is a major factor in the building industry. A dozen or more large concerns in the United States are at present engaged in the manufacture and sale of this product.

Manufacture

Although the methods of manufacture vary somewhat, certain operations are common to all products. The first step usually is to reduce the raw material to a pulp, after which the fibers are cooked and washed. The cooking dissolves the soluble matter and the washing removes it. The clean fibers are then chemically treated with waterproofing materials so that the finished board will be highly water resistant throughout its entire thickness.

The next step is the felting process by which the loose fibers are formed over large rolls or in molds into a large coherent sheet. During this operation, a large part of the water in which the fibers have been suspended is removed.

INSULATION board is popular for sheathing homes, assuring both stiffness and warmth.

The final steps are the removal of the remaining water from the sheets by means of driers, and the cutting and trimming of the board to the finished size.

Insulation board products are classified as building board, lath, roof board, sheathing, tile and plank.

Most building boards are 4 feet wide, from 4 to 12 feet long and ½, ¾ and 1 inch thick. At least one mill is producing larger sizes, up to 8 feet wide and 14 feet long. The lath sizes are 16, 18 and 24 inches wide by 48 inches long by ½, ¾ and 1 inch thick. The roof board is usually 22 x 47 inches by ½ inch and multiples of ½ inch thick.

Insulation board sheathing is generally available in the same sizes as the building board but is 25/32 inch thick, the same as that of conventional lumber sheathing. Some of the insulation board sheathings are additionally waterproofed with asphalt by means of either a surface or an integral treatment, or by means of a paper covering. Certain products also have aluminum coatings designed to give further protection.

Insulation board tile and plank are usually fabricated from the building board, manufactured according to the foregoing general process to the desired thickness. The lath is also fabricated from the building board stock in most cases, whereas the roof board is frequently a special product manufactured in a manner similar to the building board but according to somewhat different specifications to obtain certain physical properties.

Practically all insulation boards are made in single plies up to a thickness of 25/32 inch, but in some cases greater thicknesses are obtained by laminating the proper number of plies, usually ½ inch thick, by means of a water-resistant cement. These various products are further described as they are referred to in other articles and their uses are shown in Figure 1.

Physical Properties

Perhaps the outstanding characteristic of insulation board is that it combines structural strength with insulating value. This combination of characteristics is important in at least two respects, *first* because insulation board may be used where it serves both as a structural material and an insulation and *second* the structural qualities tend to perpetuate the insulating value because the insulation board is not readily compressed or otherwise damaged.

Insulation Value: Because of the millions of entrapped air voids within the fibers as well as the interstices between the fibers, insulation boards have an excellent insulating value. The unit of measure of the insulating value of a material is known as its thermal conductivity, and the average thermal conductivity of insulating boards of production-line dryness is 0.33. This is the number of Btu (British thermal units) that will pass through one square foot of the material one inch thick, in one hour, for one degree temperature difference.

Strength: The natural interlacing and interweaving of the fibers and their subsequent shrinkage during the drying process knits them firmly together and forms a grainless board of high tensile strength and stiffness.

The *tensile strength* of a material is its tendency to resist two forces away from each other to pull the material apart. The average tensile strength of insulation board used for structural purposes is about 175 pounds per square inch.

Sound Absorption: The exposed surface of insulation board has a degree of sound absorption and for this reason is an effective material for acoustical correction and noise quieting in auditoriums, theatres, offices and other enclosures in which the hearing properties are important. Another equally important characteristic of this type of product is its tendency to reduce sound transmission through floors and partitions, when properly installed. These subjects are discussed in detail in another article.

Resistance to Air Leakage: Insulation boards are practically impervious to air leakage under ordinary conditions. Even at high wind velocities the amount of infiltration directly through products of this type, when used in combination with other materials, usually is insignificant. This fact is of considerable practical importance from the standpoint of heating costs.

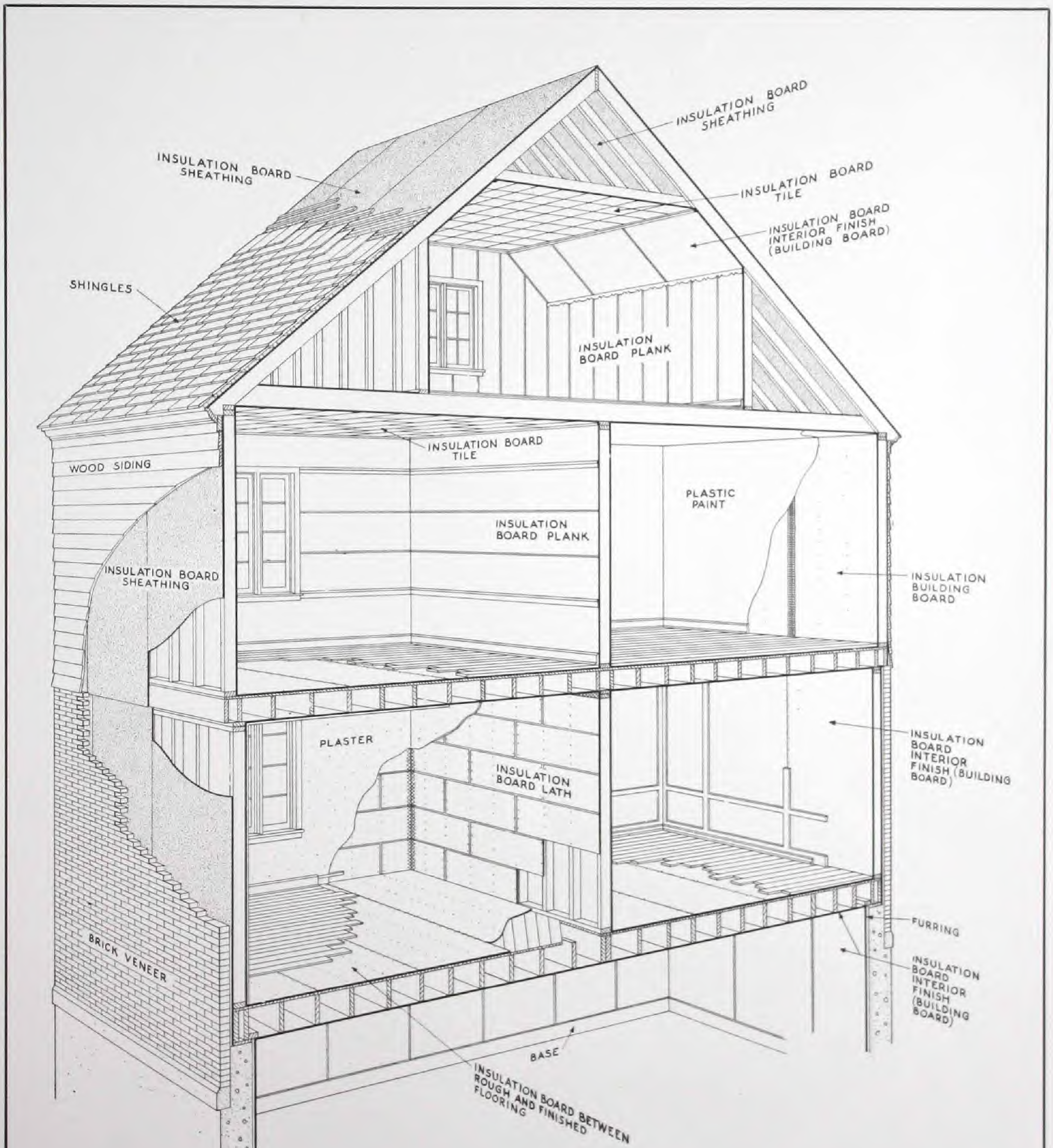


Figure 1. Section of building showing typical uses of insulation board.

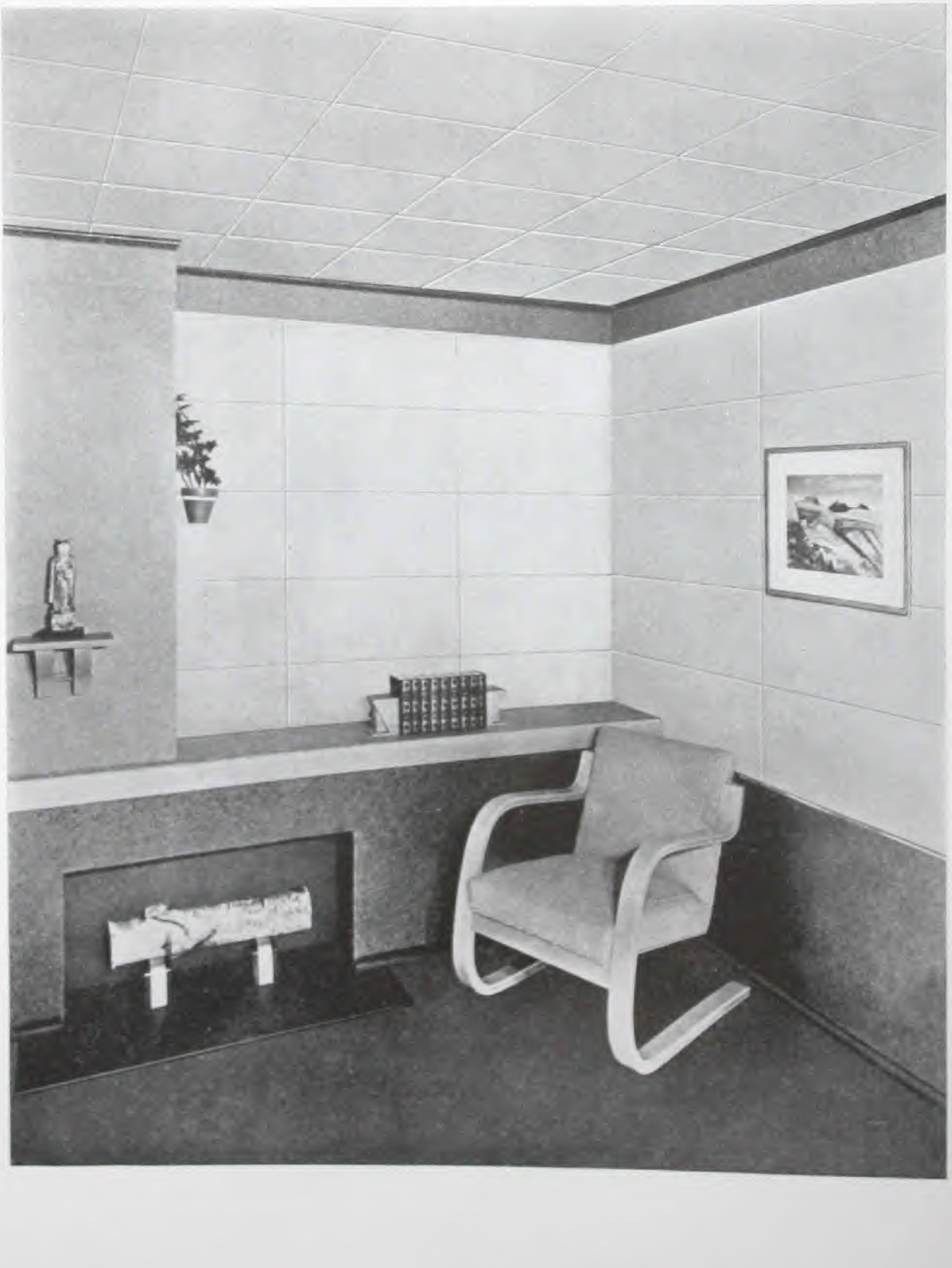
Beautiful Interiors Obtained with Insulation Board Products

INTERIOR wall and ceiling finishes of beauty and charm are obtainable by means of insulation board interior finish products. These products include the tile and plank specifically designed for this purpose as well as the large-sized building and insulating boards, which are also suitable for decorative purposes. Insulation board interior finish products not only provide attractive and economical interiors, adapted to practically any decorative scheme or motif, but also serve as heat and "cold" insulation, acoustical correction and noise quieting. Special acoustical materials are also available.

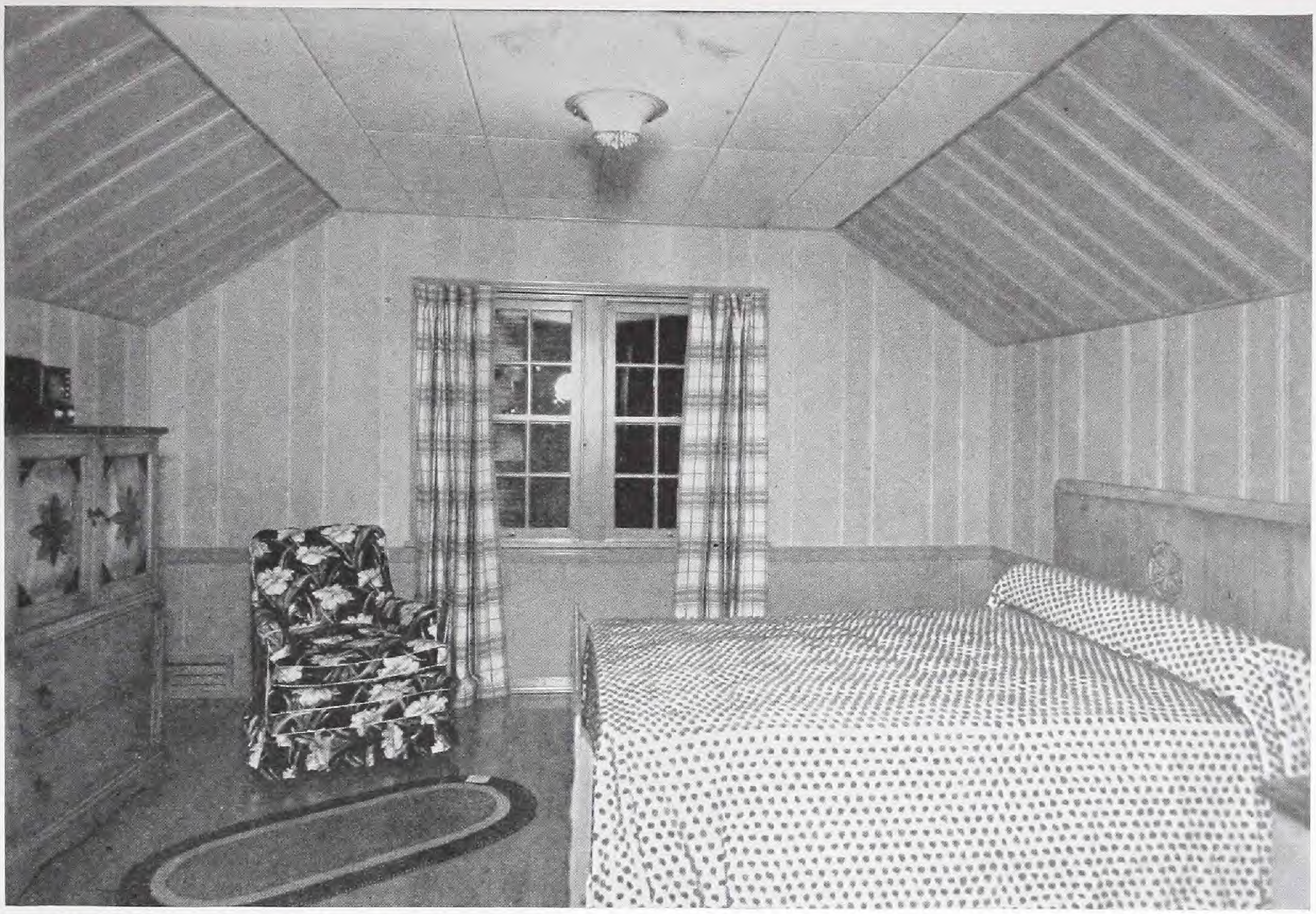
Churches, lodges, auditoriums, school-rooms, restaurants, taverns, hospitals and residences are a few of the buildings for which these interior finish products are especially adapted. Residence uses include recreation rooms, living rooms, dining rooms, bedrooms and attics.

The large boards are available in a variety of colors and textures and generally are ½ inch and 1 inch thick, 4 to 8 feet wide and 4 to 14 feet long. Tile boards are small square and rectangular units of convenient sizes, whereas, the plank, as the name implies, are long narrow units produced in various widths and lengths. The plank and tile are usually ½ inch thick and are also available in a variety of tints and textures. The accompanying illustrations show a few of the design possibilities of insulation board interior finish products. The building boards may be V-grooved, carved or beveled, for various attractive designs. Modern or period paneling may be obtained by using mouldings of insulation board, wood or metal. Insulation board and wood mouldings are now obtainable in a variety of colors.

Beveled panels (tile) are used primarily for ceilings. Because of the many sizes available, both in the square and rectangular tile, a wide range of patterns is possible, such as herringbone, ashlar, basketweave, plaid, rectangular and diamond. Insulation board plank are used mainly for wall



THE ATTRACTIVE finish of this insulation board, combined with invisible nailing of the wall and ceiling panels, results in a number of new decorative possibilities for this economical surfacing material.



DECORATIVE vertical planking of insulation board combines with insulation board wainscot and ceiling in this Ohio bedroom.

INSULATION BOARD in large sizes for side walls and ceilings makes possible beautiful interiors like this.

treatment, and the various widths available make it possible to obtain regular or random plank effects. The plank may be applied either vertically or horizontally. Vertical lines emphasize height whereas horizontal lines emphasize length and width.

Wainscots are frequently desirable in modern and period wall treatments. They are used to reduce the apparent height of a room or to introduce color. Either the building board or harder non-insulating pressed wood boards are suitable for this purpose, using plank, beveled panels (tile) or building board above the wainscoting.

Overlay borders and friezes made from insulation board relieve harshness and monotony in a design. Ornaments and mouldings for embellishing or modifying a given pattern or motif are available, or may be cut from insulation board by means of special tools. Where two surface textures are available, they may be alternated to produce attractive effects.

Beveling and Grooving

By means of special tools which have been developed for the purpose, the large building boards may readily be beveled, grooved or hand carved. One of these tools is similar to a carpenter's plane and utilizes tool steel blades which may be used indefinitely if properly honed. This tool has adjustments for varying width and depth of cuts, and spacing of grooves. A supplementary tool or knife is used for freehand carving where the beveling and grooving tool would be unwieldy.

Some of the operations possible with these tools include square and beveled edges, V-grooves of varying widths, diagonal grooves edge to edge, edge to groove or groove to groove, and inside grooves "faded" by gradually lowering and raising tool. Overlays and perfect circles can be obtained as well as freehand curves and sweeps; also V-grooves in fluted designs and miter and slip joints.

Methods of Applying

Proper application of insulation board for interior finish purposes is important and the specific instructions of the manufacturer of the product used should be followed for best results. The following details of application will however serve as a general guide.

Interior finish products may be applied by nailing to framing or furring or by cementing to continuous, smooth surfaces. When attached to a nailing base, the framing should correspond with the size or type of product used but in no case should be installed on greater than 16 inch centers. Furring strips for plank should be at right angles to plank on 9 inch centers up to a height of 3 feet and 12 or 16 inch centers above this height. It is especially important that the framing or furring for tile units should carefully conform to the size of units used. Headers are recommended in back of chair rail and all other heavy mouldings.

Where nailing is to be exposed 1¼ inch finishing nails or 1¼ No. 16 brads for ½ inch thick insulation boards should be used and driven at an angle, setting nail below surface and tapping fiber over surface. Nails may be driven in beaded groove of plank. Where nails are to be covered with panel strips or mouldings, use ordinary 1½ inch nails.

Insulation board interior finish products may also be applied to sound plaster, smooth wood, plasterboard and other continuous surfaces by means of special adhesives available for this purpose, but for best results supplementary nailing is recommended where possible. For application over metal ceilings, rough plaster or other irregular or unsound surfaces, furring strips should be installed and the insulation board nailed thereto in accordance with the foregoing instructions.

PRIVATE OFFICE is both decorated and quieted by this wall and ceiling treatment in insulation board.

REMODELING is easily and effectively done with Insulation Board, as illustrated in the above photos showing (above) a St. Paul basement refinished into a smart recreation room, at small cost.

Where the larger building board is to be cemented, the adhesive should be applied in ribbons 3 to 4 inches wide along all edges with two intermediate ribbons, one each parallel to and approximately 16 inches from the long edge. In some cases the adhesive may be applied in spots 3 or 4 inches in diameter and spaced 6 or 8 inches apart along all edges with two intermediate rows of spots applied lengthwise.

The adhesive should be applied to the short edges of plank in ribbons 3 or 4 inches wide with additional intermediate ribbons of adhesive about 10 inches apart. Apply the adhesive to tile in spots 3 or 4 inches in diameter, one in each corner and additional spots on the larger sizes.

The adhesive may also be applied over the entire surface to be bonded, if desired.

It is particularly important that sufficient adhesive be used, especially in the case of rough surfaces, for which a heavy-bodied adhesive is preferable. Intimate bond is obtained by sliding the units in place, using a pressure sidewise and against the surface to be finished.

Cleaning and Maintenance

Dust may be removed from the surface of insulation board by brushing lightly with a whiskbroom, by rubbing with another piece of insulation board, by vacuum cleaning with a brush attachment, or by means of wall-paper cleaner. Heavy smudges may be removed with fine sandpaper. Grease spots are removed by several treatments with a rag or sponge soaked in naphtha.

RESTAURANTS gain patronage when quieted and stylized by insulation board finish. The SooChu (Minneapolis) shows a ceiling of two-tone tile, while the Point Pleasant (New York) Hotel Dining Room, above, uses the same design but reversed in color.

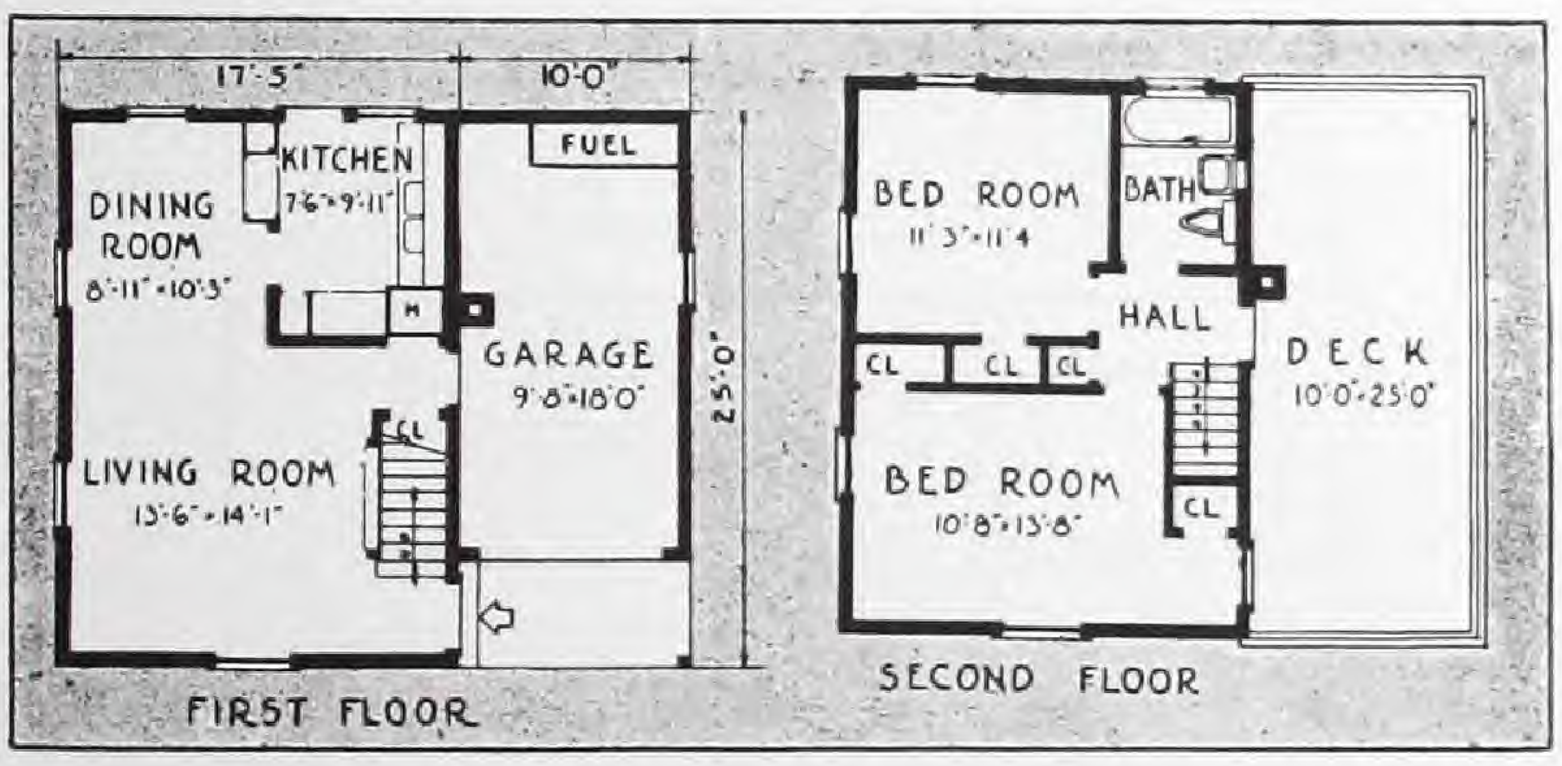
Insulation Board Adapted to Demonstration Houses

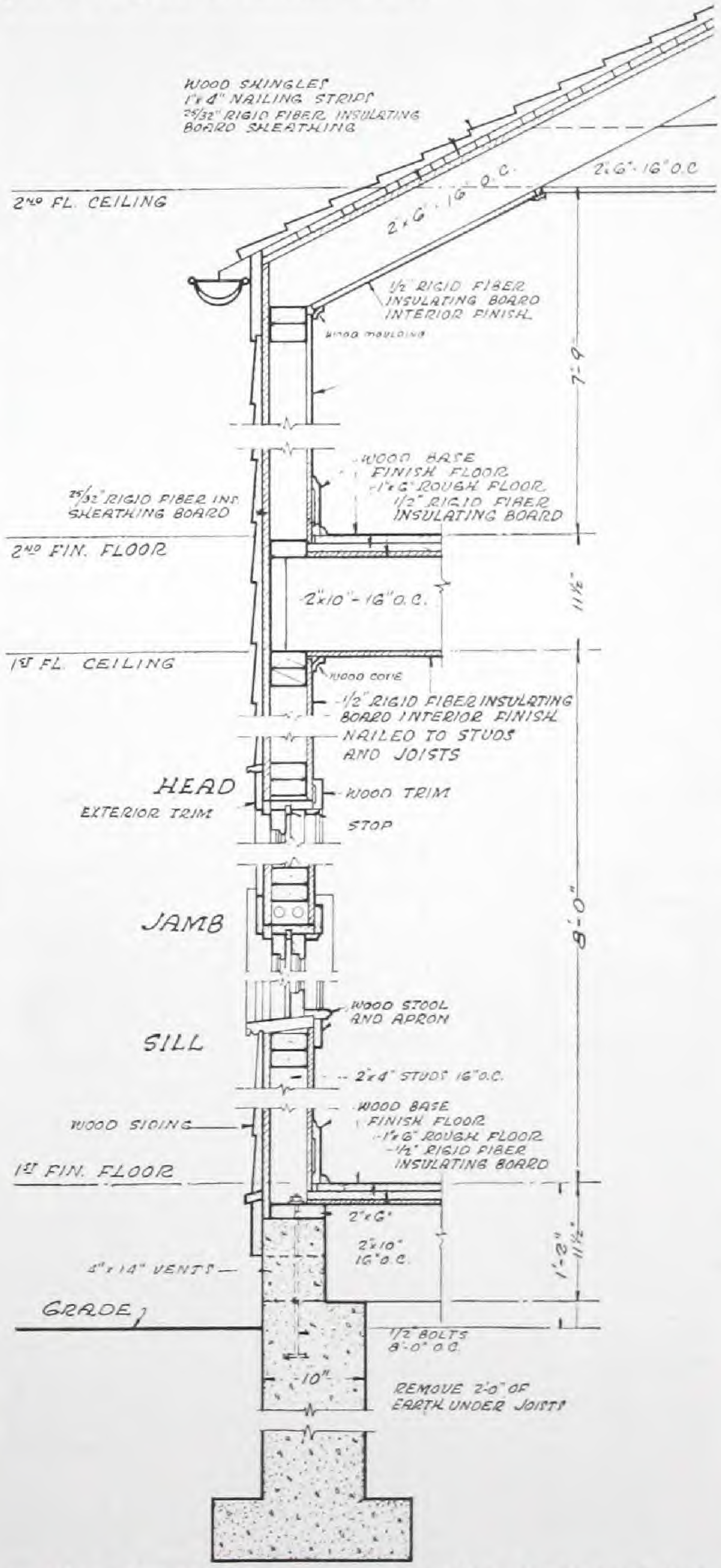
THE National Small Homes Demonstration, Inc., is an informal, non-profit organization established by the National Lumber Manufacturers Association and the National Retail Lumber Dealers Association in cooperation with manufacturers and distributors of home building materials and equipment, to "work together toward better homes" and "to interest progressive and alert dealers and builders . . . in the production of demonstration homes from the designs" which the NSHD has prepared.

With the idea of cooperating with this movement, the engineers of the Insulation Board Institute have analyzed design 1-D of the current portfolio, a 5 room two-story house, for the purpose of showing how insulation board may be adapted to a house of this type. Thus builders who propose to construct homes of this design are enabled readily to make use of insulation board throughout if they so desire. This material is particularly suitable where dry-wall construction is preferred. The details shown herewith are more or less typical and may be adapted to any of the NSHD designs.

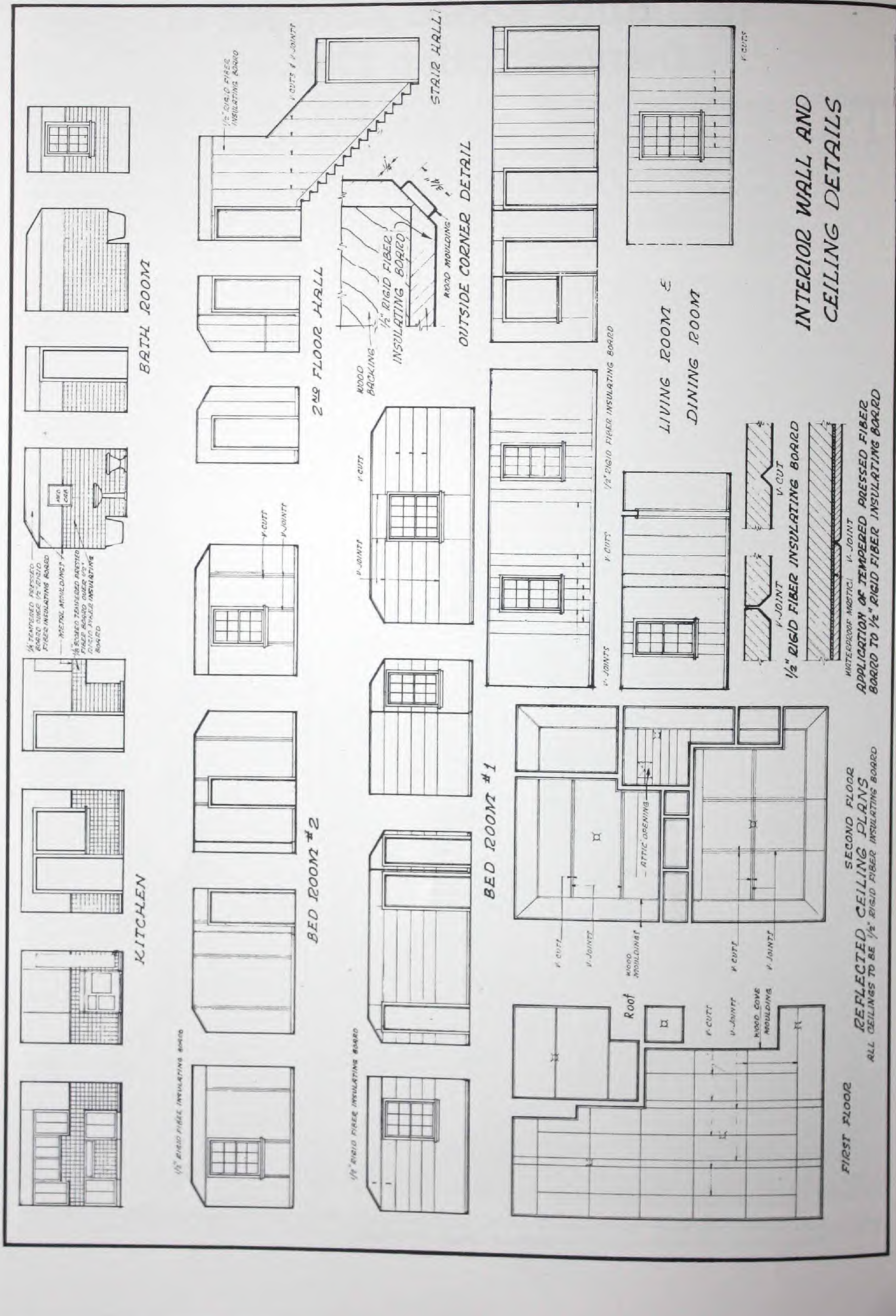
In this design, insulation board is used principally as exterior wall sheathing, as interior finish, as sound insulation between the rough and finish floors, and as roof insulation between the roof rafters and nailing strips for the shingles. Where used as interior finish on exterior walls and top floor ceilings, the insulation board serves also as insulation. Therefore, all exterior members of the house have a double thickness of insulation board.

The wall and roof section shows the application of various types of insulation board to both sides of studs, rafters and floor joists and to the underside of ceiling joists. The interior finish details illustrate typical uses of insulation board for this purpose. The living room and dining room wall designs are based on the use of the large building boards V-grooved vertically as shown to produce the desired effect. Similarly attractive designs could also be obtained by the use of insulation board plank in regular or random widths.





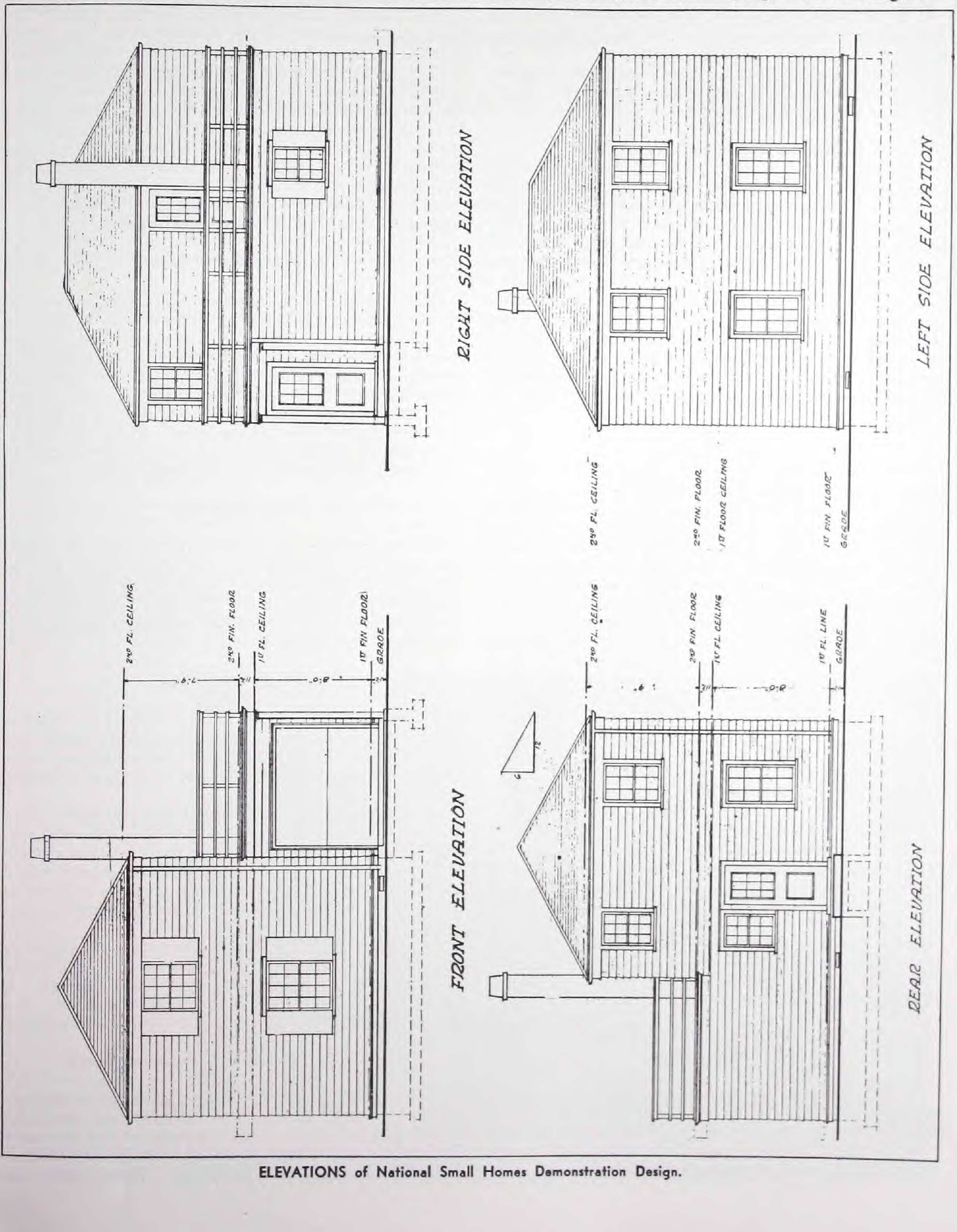
HOW to build the Nat. Small Homes Demonstration Design I-D using insulation board for side wall and roof sheathing and for inside finish (walls and ceilings) of all rooms.


INTERIOR WALL AND CEILING DETAILS
KITCHEN
BATH ROOM
BED ROOM #2
2ND FLOOR HALL
STAIR HALL
BED ROOM #1
OUTSIDE CORNER DETAIL
1/2" RIGID FIBER INSULATING BOARD
WOOD BACKING
WOOD MOULDING
LIVING ROOM & DINING ROOM
V-JOINT
V-CUT
1/2" RIGID FIBER INSULATING BOARD
WATERPROOF MASTIC
APPLICATION OF TEMPERED PRESSED FIBER BOARD TO 1/2" RIGID FIBER INSULATING BOARD
ATTIC OPENING
Roof
FIRST FLOOR
SECOND FLOOR
REFLECTED CEILING PLANS
ALL CEILINGS TO BE 1/2" RIGID FIBER INSULATING BOARD

The ceiling layout for the first floor is also based on the use of the large building board, the proper design effects being obtained in this case also by the use of V-joints, as illustrated. Desirable ceiling patterns may also be obtained by using insulation board tile instead of the building board V-grooved. Insulation board ½ inch thick is used as insulation on the walls of kitchen and bathroom. These walls are finished with tempered pressed board, the insulation board tile being applied as wainscoting and the smooth-surfaced board above the wainscoting.

The various patterns for the bedrooms and halls, involving the use of insulation board, are also shown. These designs are readily obtained by means of the standard insulation board grooving, beveling and cutting tool referred to in the interior finish article.

As the insulation board serves a double purpose in many instances, the insulation value thus obtained is derived at a cost emphasizing the low-cost purpose of the design.



ELEVATIONS of National Small Homes Demonstration Design.

Insulation Board Ideal Base for Paint and Wall Coverings

WHERE dry wall construction is preferred, insulation board may be used in the natural colors as interior finish (as described in the preceding chapter) or it may be used as a base for decorative finishes of various types including paints, stains and wall coverings. In either case, it serves at least two purposes, since it also functions as an insulation when used on outside walls and top floor ceilings.

Calcimines, Casein and Water Paints

Calcimine and water paints may be applied directly to unsized insulation board although calcimines may also be applied to varnish sized surfaces to facilitate removal by washing. Water paints of the casein base class are washable to a certain degree but not quite so much so as oil or varnish paints.

A single coat of good casein base water paint will usually give good coverage on insulation board, although two coats are recommended. Some of these paints are available tinted in a variety of attractive pastel shades. Others can be tinted from the white by the addition of dry colors in accordance with manufacturers' directions.

Stains

Stains may be used where the natural color of the insulation board is to be modified without destroying the texture and where its sound absorbing properties are of importance. While a variety of stains are available, glue stains usually give the best results on insulation board. A satisfactory glue stain may be made by dissolving ½ pound of flake or ground glue in a gallon of boiling water.

After the glue has been thoroughly dissolved, dry color is added in amounts depending on the depth of tone required. The dry colors are best added by mixing them with a small amount of water, stirring to a thin paste which is more easily taken up by the glue solution. Glue stains of this type must be used promptly after preparation. They should, if possible, be applied while they are still warm. Alcohol stains are not recommended—they dry too rapidly, leaving brush marks.

Oil or Varnish Paints

Insulation board must be properly sized before application of oil or varnish paints. A satisfactory glue size may be made by dissolving 1½ pounds of chip or flake glue in a gallon of boiling water. Various prepared oil or varnish sizes, ready mixed and properly proportioned for direct application to insulation board, may be obtained. The best results are obtained if the surface is sanded lightly after the size coat has dried thoroughly. The paint may be applied to the surface thus prepared using the desired number of coats for satisfactory results.

Covering Joints for Applying Plastic Paint & Wall Coverings

Where plastic paint or wall coverings are to be applied over insulation board, some authorities are recommending that all joints between boards should be reinforced, using wire screen or buckram tape. The wire mesh or tape should not be nailed or tacked in place except when starting a joint and occasionally on ceiling strips to hold in place while applying cement.

Hold one end of strip while the bonding cement is applied to the surface of the reinforcement and press through the mesh with a 4 inch painter's scraping knife. Spread the bonding cement beyond the edges of the reinforcement for not less than 1 inch so that the edge of the mesh will not show through the plastic paint finish. In bonding the reinforcement over the joints, press firmly against the insulation board and fill mesh well with the bonding cement applied in the consistency of putty. Apply, similarly, a strip of reinforcement bent around all corners and re-entrant angles. For more detailed information, refer to manufacturer's specifications.

Applying Plastic Paints

Plastic paints are thick paints which can be textured by manipulating the brush or various tools to produce various textures and effects. They are divided into two groups—those prepared by the addition of water to a powder and those having a linseed oil base furnished prepared for use. Water base plastic paints, unless excessively alkaline, can usually be applied directly to unsized insulation board. For oil base plastic paints, the insulation board should be sized in accordance with the instructions under the heading, Oil or Varnish Paints.

Wall Coverings

Wall papers, canvas, fabrics such as Sanitas, leather and even thin plywoods and thin metal sheets may be applied to certain insulation boards. Wall paper may be applied over a lining paper if desired. Manufacturers should be consulted for specific recommendations as to this use of their product.

Stencil Decoration

Where a light touch of color is desired or where a means of accentuating a design is sought, stencils are recommended. Border stencils are particularly attractive on insulation board interiors, and are approved by leading decorators.

Stencil designs may be cut in oil paper or metal. They are held in position by hand or by thumb tacks while the color is applied with a stiff stencil brush. Colors ground in Japan are recommended. The Japan color paint should be thinned to the desired consistency with a mixture of six parts turpentine, three parts linseed oil and one part Japan drier.

Artistic decorative effects may be produced by carving the surface of insulation board, particularly in the case of large relief carving where detail is not required. A design is first laid out in pencil and razor blades or a sharp knife are then used to carve the insulation board.

Procedure for Installing Insulation Board

The framing or furring is installed in the usual manner on 12 or 16 inch centers. Headers are cut in between framing members at the ends of the insulation board to provide a nailing base and also in back of chair rails and all other heavy mouldings. Where paints and

stains are to be used, the insulation board is attached by means of finishing nails, driven at an angle and set flush. Otherwise 1½ inch box nails are used, except where 1 inch insulation board is to be installed, in which case 2 inch box nails are used.

The insulation board should be placed singly around the room for at least 24 hours prior to erection to allow adjustment to atmospheric conditions. Boards should be of sufficient length to span completely between sills and plates or other structural members. A space of ⅛ inch should be left between boards and at the ends of boards. Most products are cut scant for this purpose. The insulation board is nailed first to intermediate framing members, and then the edges are nailed. On intermediate framing members, nails are spaced 6 inches apart. Nails are spaced 3 inches apart at edges and ⅜ inch away from edges and driven in until the heads are flush with the insulation board surface.

Insulation Board Sheathing

FOR many years, lumber ranging in width from 6 to 12 inches and applied horizontally or diagonally has been considered the standard wall sheathing. In recent years, however, insulation board has also been used extensively for this purpose and at the present time is rapidly increasing in popularity among architects and builders.

Purpose of Sheathing

What is the purpose of wall sheathing or boxing? In the first place, it provides a measure of protection against the weather—heat, cold and wind. Another purpose is to tie the framework together and to provide a base for the exterior finish. A third and extremely important function is to increase the rigidity of the building so that it will resist distortion by wind stresses, thus minimizing cracks and other damage.

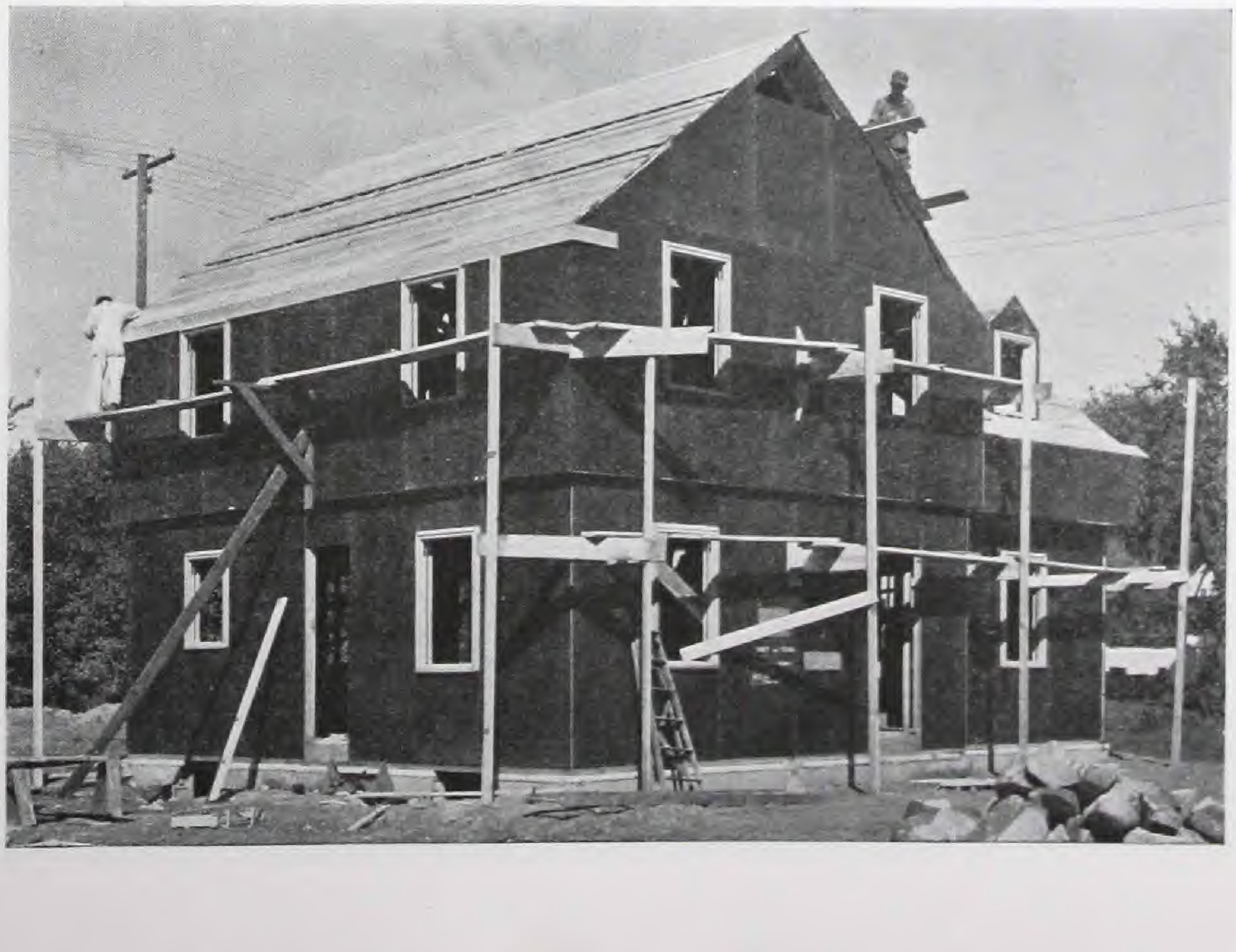
Let's analyze these reasons for using wall sheathing to determine the fitness and adaptability of insulation board for this purpose. Insulation board sheathing is available in large units, 4 to 8 feet wide and up to 14 feet long and 25/32 inch thick. Special sheathings two feet wide and 8 feet long, applied horizontally, are also available. Various supplementary waterproofing treatments are used in connection with some of these products such as asphalt applied to all surfaces, with or without an additional aluminum coating on one surface, an integral asphalt treatment, and paper applied to the surfaces.

As an insulating material this type of sheathing more effectively resists the passage of heat which means greater year round comfort—cooler in the summer and warmer in the winter, plus fuel economy. It is not only devoid of knotholes and cracks through which air leakage due to wind pressure can take place, but the board itself is practically impervious to air infiltration. Insulation board in the large units is applied vertically and is nailed to the framing on all four edges. Thus it provides a smooth, continuous surface for the exterior finish.

Bracing Strength

The average individual will readily concede these points, but may perhaps ask if this type of product has sufficient strength. He may pick up a piece of insulation board and find that he can break it, and thereby conclude that it is not strong enough to be used for wall sheathing.

The answer to this question involves a principle with which few people, especially those unfamiliar with building construction, are aware. It is that although one material may be "stronger" than another when individual



INSULATION board used as wall sheathing. Waterproofing and vapor barrier features make this material extra serviceable in these days of humidification.

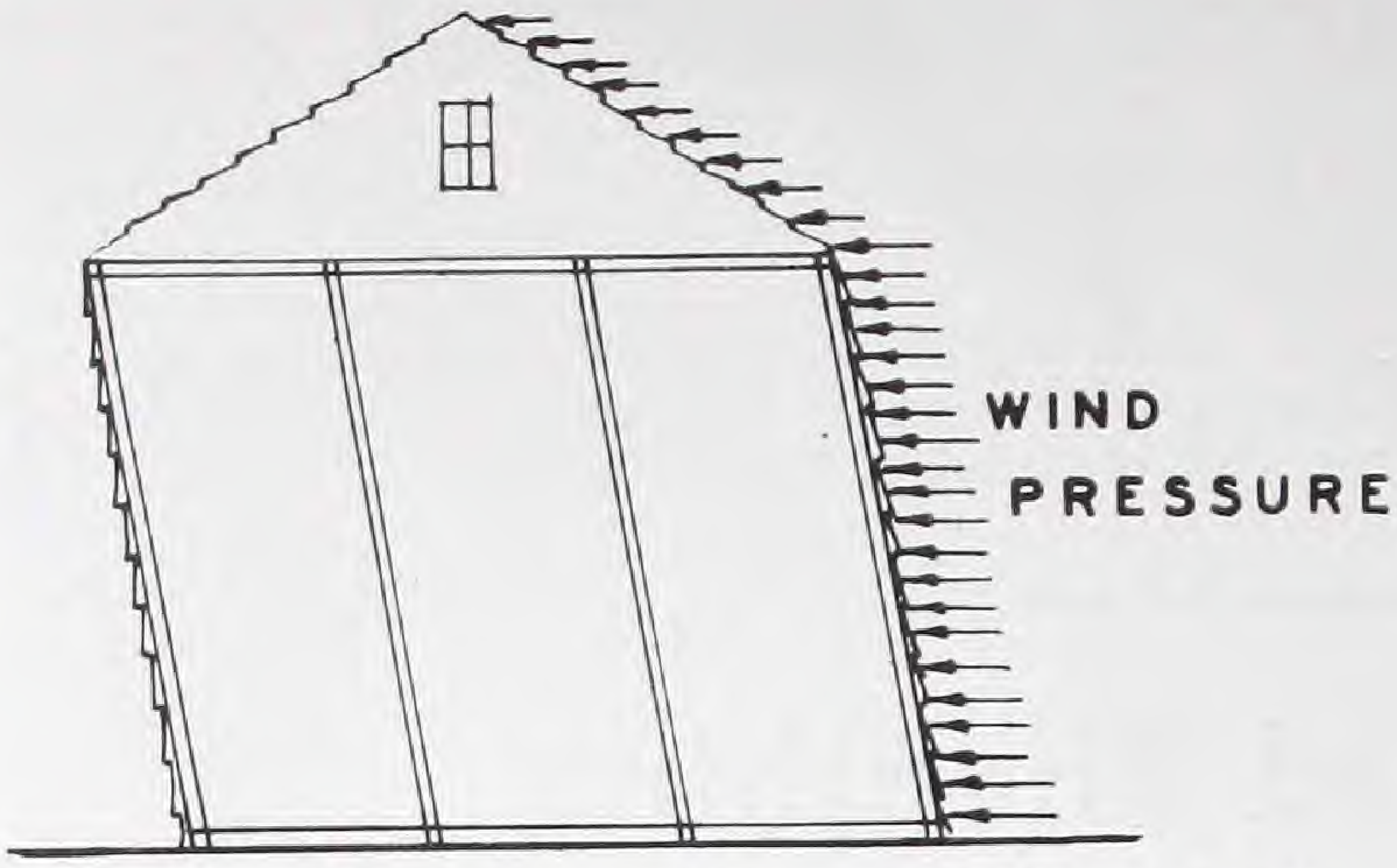


Figure 1. Sheathing removed from end; building distorted.

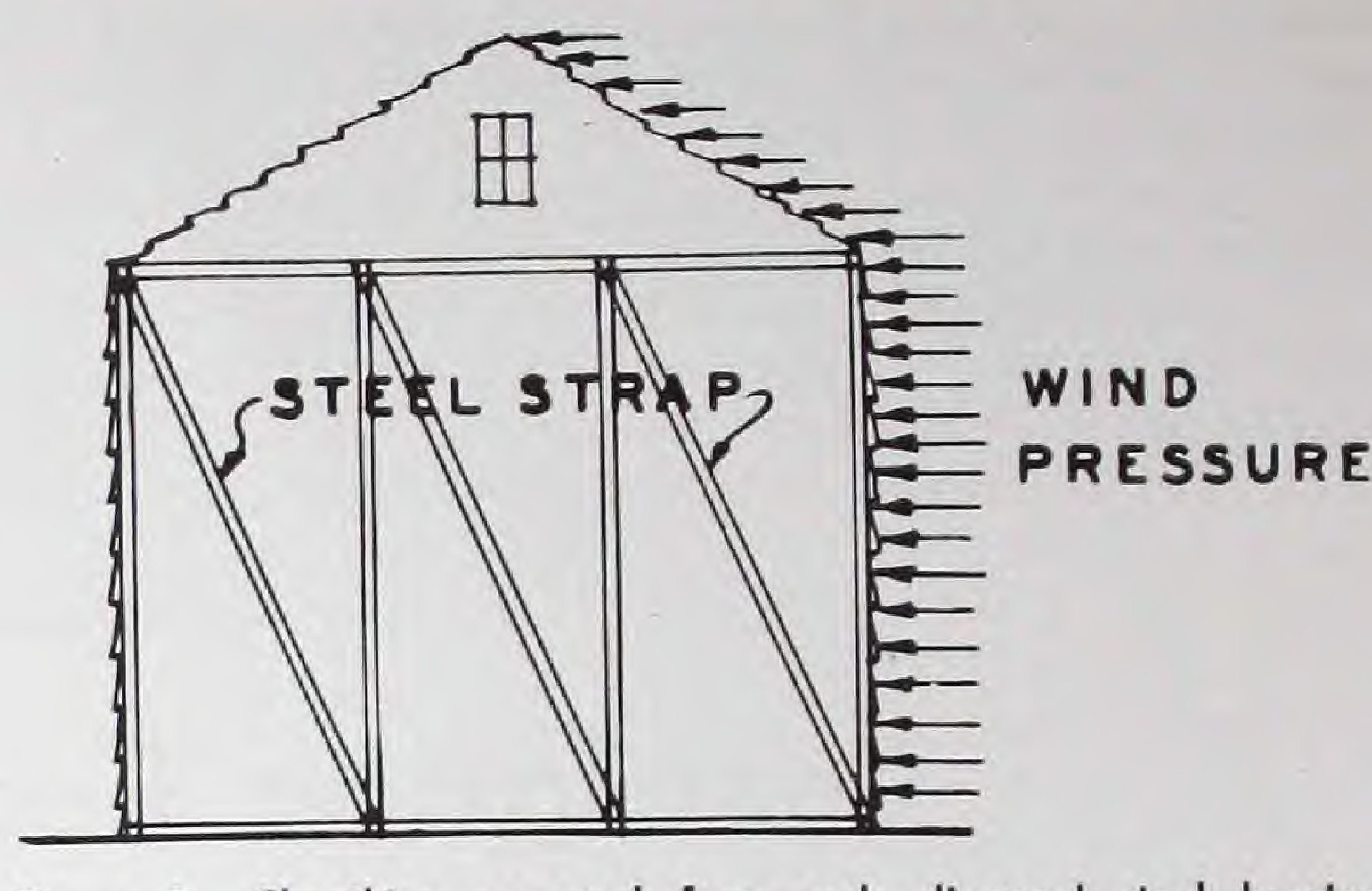


Figure 2. Sheathing removed from end; diagonal steel bracing straps under tension; building not distorted.

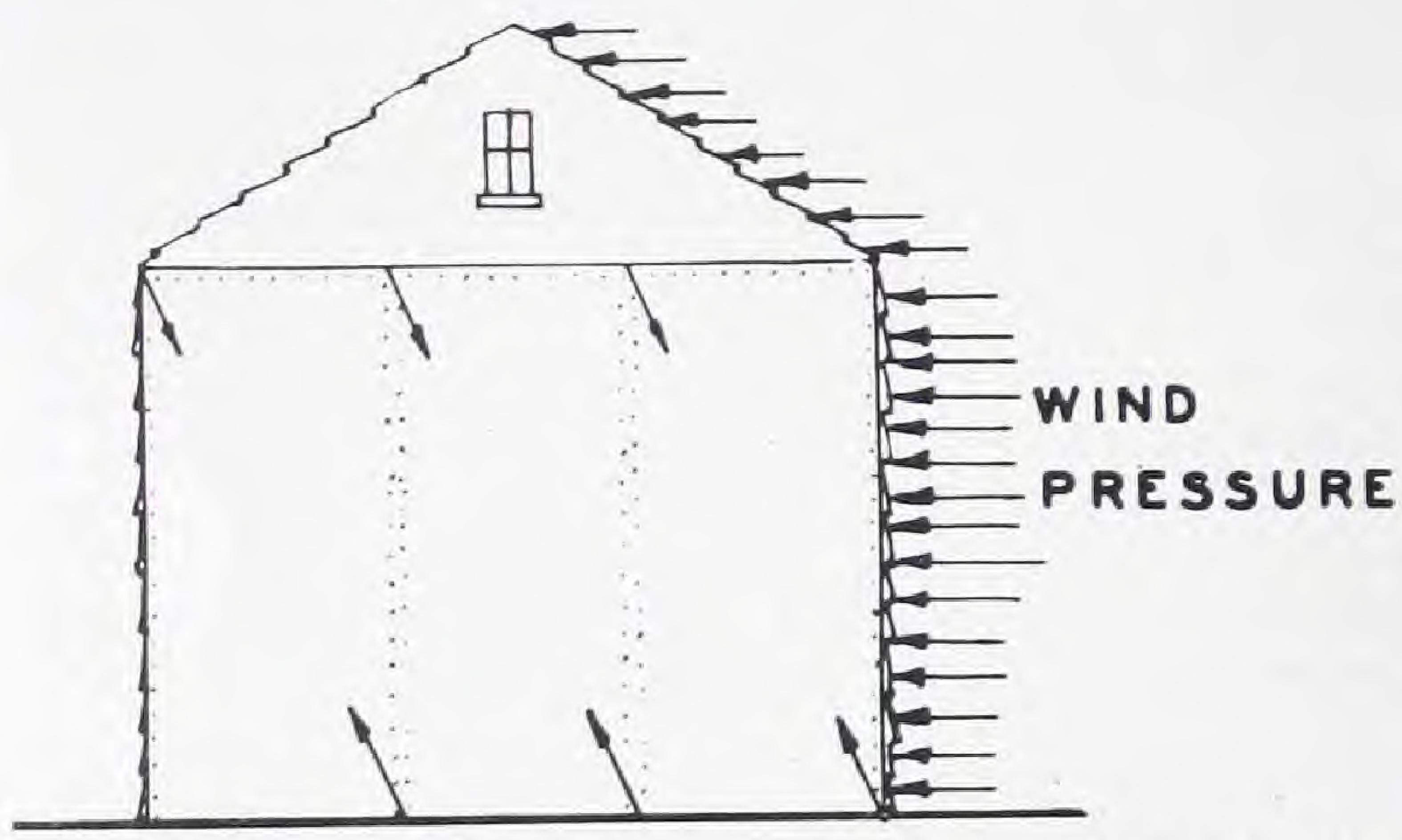


Figure 3. Insulation board sheathing under diagonal tension, same as steel straps in Figure 2; building not distorted.

Figure 4. Conventional sheathing on ends; very little diagonal bracing obtained; boards tend to slip edge upon edge, distorting building.

pieces of the same size are considered, the reverse may be true as far as the entire wall is concerned when the two materials are installed in the usual commercial sizes in which they are available. A wall sheathed with large units of insulation board possesses far greater bracing and stiffening properties than a wall sheathed with narrow units of any material applied horizontally.

The accompanying diagrams illustrate this point. Figure 1 shows the effect of wind pressure on the side of a building from which the sheathing at the ends of the building has been removed. The ends are distorted. If now the building should be braced with diagonal steel straps as shown in Figure 2, the building will not be distorted but will remain upright. These straps are subjected to pulling as tensile stresses.

If the steel straps are removed and the ends of the building are sheathed with insulation board, the insulation board is pulled diagonally subjecting it to tension as shown in Figure 3. The effect of wind pressure on a horizontal sheathed building is shown in Fig. 4. The sheathing boards tend to slip edge upon edge, due to the wind pressure. It is apparent therefore that the bracing contributed by insulation board means that a building sheathed with this material is not distorted under the same wind pressures that distort a horizontally sheathed building or under the same forces set up due to settling of the foundation.

Many laboratory and field tests have been made to verify the rigidity or resistance to distortion of wall sections sheathed with insulation board. A convincing field test which has been conducted thousands of times is known as the tug-of-war. In this test, similar panels of insulation board and lumber are bolted to a heavy framework, and a turnbuckle placed between the two panels. The U. S. Forest Products Laboratory at Madison, Wisconsin, has made a series of tests extending over a period of years. These tests were based on large room sized panels and proved conclusively that walls sheathed with insulation board 25/32 inch thick are substantially more rigid than walls sheathed with lumber applied horizontally.

Has Stood Test of Time

While tests and statistics prove beyond doubt the merits of insulation board sheathing, some may question whether a material of this type will stand up indefinitely. The original sheathing installations of this product were made 25 years ago and since then hundreds of thousands of buildings have been constructed using this type of sheathing. A large percentage of these were sheathed with ½ inch insulation board, whereas at the present time the 25/32 inch thickness is commonly used, the latter thickness being especially developed for this purpose. The results over this period of time have been entirely satisfactory and there is no evidence that there is any limit to the length of service of insulation board sheathing.

Comparative Costs

The next consideration is cost. No matter what the merits of a material, if the cost is out of line, the contractor or the home owner or the architect is not likely to be interested. The material cost of 25/32 inch insulation board sheathing is usually slightly higher than that of lumber sheathing. But this is offset in a measure by the greater amount of waste in the case of lumber which is usually 20 or 25 percent, as compared with practically no waste when insulation board is used because the pieces cut out from openings are large enough to be used elsewhere. Many contractors who use insulation board sheathing say that when they get through with a job they do not have a bushel basket full of pieces left.

The application cost of insulation board sheathing is less because the large boards can be handled and nailed faster. Most contractors agree that they can apply insulation board in about 60 percent of the time required for wood sheathing. Furthermore, building paper is not needed over insulation board, except under stucco. This, of course, means a saving on the labor of application as well as on the paper.

How these figures will add up of course depends on the locality and the specific job involved. In some sections of the United States, material and labor costs are such that 25/32 inch insulation board sheathing actually costs no more in place than lumber sheathing and building paper. The maximum difference between the two seldom exceeds $10.00 a thousand square feet of wall area covered.

Application

The procedure for applying insulation board sheathing is in general the same as that for wood sheathing, there being a few minor respects in which the methods differ. Studs should be erected as in ordinary frame construction on 12 or 16 inch centers and two by four headers inserted between framing members at the ends of all insulation boards to serve as a nailing base. Use 2 inch galvanized nails with ⅜ inch or ½ inch heads, or 8d common nails for 25/32 inch insulation board. For ½ inch board use 1½ inch galvanized roofing nails with ⅜ inch heads. Apply the large insulation board units lengthwise (vertically) and directly to all framing members, with ample bearing for nailing along all edges. Nail to intermediate framing members first, spacing nails 6 inches apart; and then along the edges, spacing nails 3 inches apart and ⅜ inch in from the edge. Drive nails until the heads are flush with the surface of the insulation board.

Never force insulation boards in place. Leave a ⅛ inch space between adjoining boards and at ends of boards. Most insulation boards are cut scant in width and length to allow for this space. Where 2 foot by 8 foot sheathing is used, it should be applied horizontally in accordance with manufacturers' specifications. Bring sheathing into close contact with frame around windows. Certain boards should be moistened lightly in dry weather, the day before application, as directed by the manufacturer. Flash windows, doors and other cased openings with strips of metal or prepared roofing.

Application of Exterior Finish

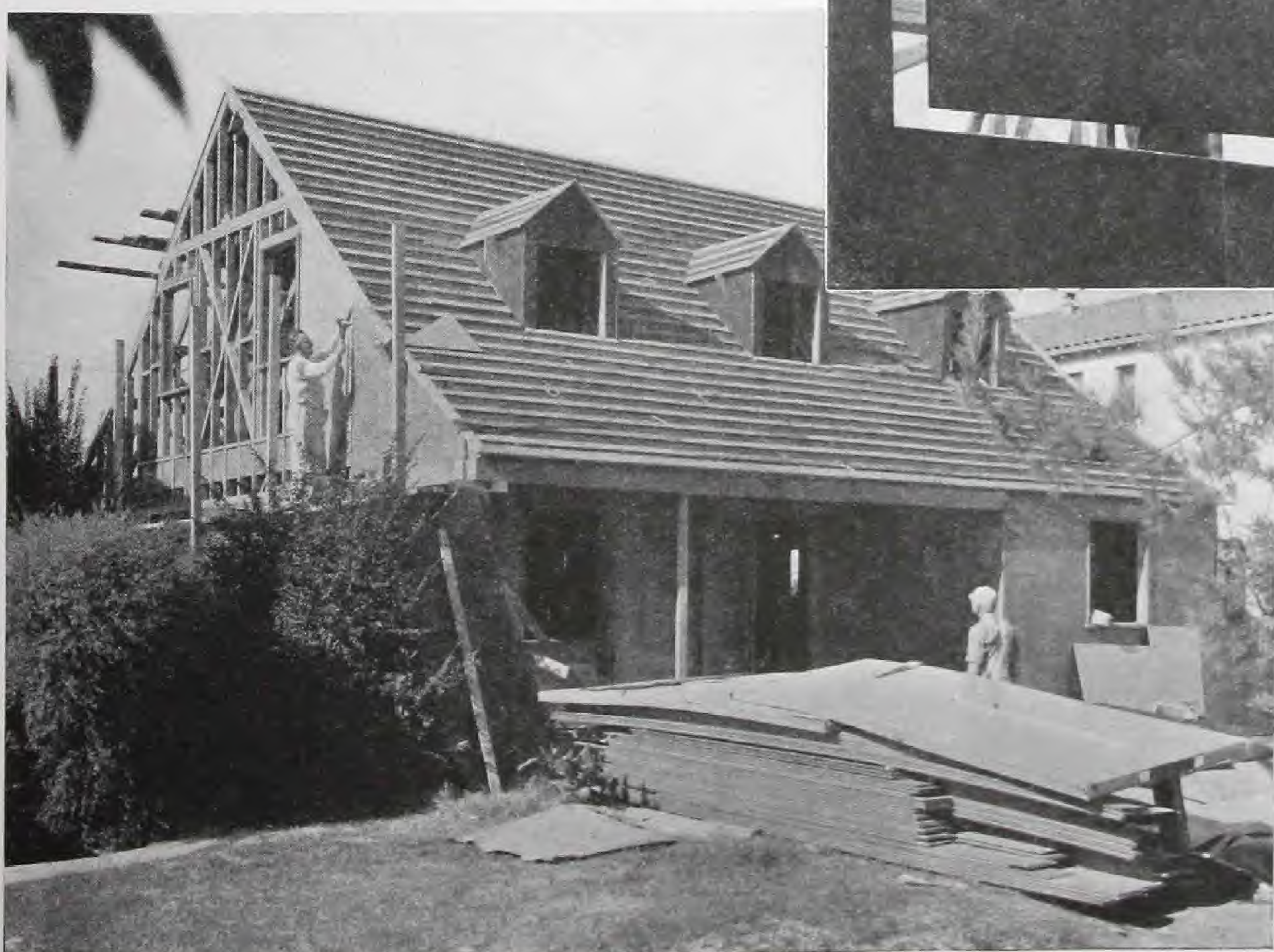
Wood siding may be applied directly over the insulation board, nailing through to the studs. Siding boards should butt over studs. Where shingles are to be used, nail 1 x 2 furring strips horizontally over insulation board to studs, spacing to fit the shingles. Nail shingles to furring strips. For brick or stone veneer, properly space anchors and nail through the insulation board into the studs. Lay the brick or stone in the usual manner. Allow not less than ½ inch space between the insulation board and the brick or stone. If stucco is to be used as exterior finish, it is generally considered good practice to apply a layer of asphalt saturated roofing felt over all surfaces to receive stucco. Self-furring and non-furring stucco bases should be applied in accordance with the manufacturers' specifications.

Insulation board serves the double purpose of sheathing and insulation. As an insulation it saves fuel in winter and provides greater year-round comfort which means cooler interiors in summer. In addition to its insulation value, insulation board eliminates air leakage because there are no cracks or knot holes. Structurally a wall sheathed with insulation board is much stronger because it has bracing and stiffening properties.

As to cost, there is little difference in most cases between insulation board and wood sheathing, as applied. This is because there is little or no waste with insulation board and it can be applied faster. Furthermore, it is not necessary to use building paper in most cases.

This type of sheathing has stood the test of time.

HORIZONTAL sheathing units 2' x 8' make shiplap joints on long edges.



RESIDENCE in Los Angeles braced and insulated with structural fiber board.

Insulation Board Lath Solves Many Plaster Base Problems

INSULATION board lath is an ideal plaster base. It provides a smooth, beautiful wall free from lath marks and serves the dual purpose of insulation and plaster base.

The thicknesses available—½ inch and 1 inch—make it possible to vary the amount of insulation to meet the specific requirements of each job. Insulation board lath of the proper thickness applied to the inside of the studs together with insulation board sheathing on the outside of the studs provide a well-insulated wall of sufficient heat resistance for practically any climatic condition or type of fuel. This construction also provides the all-important breathing space between the studs. Plaster on the surface of insulation board lath does not in any way impair its insulating efficiency. This type of lath plus the plaster makes a tight wall that is practically impervious to wind infiltration.

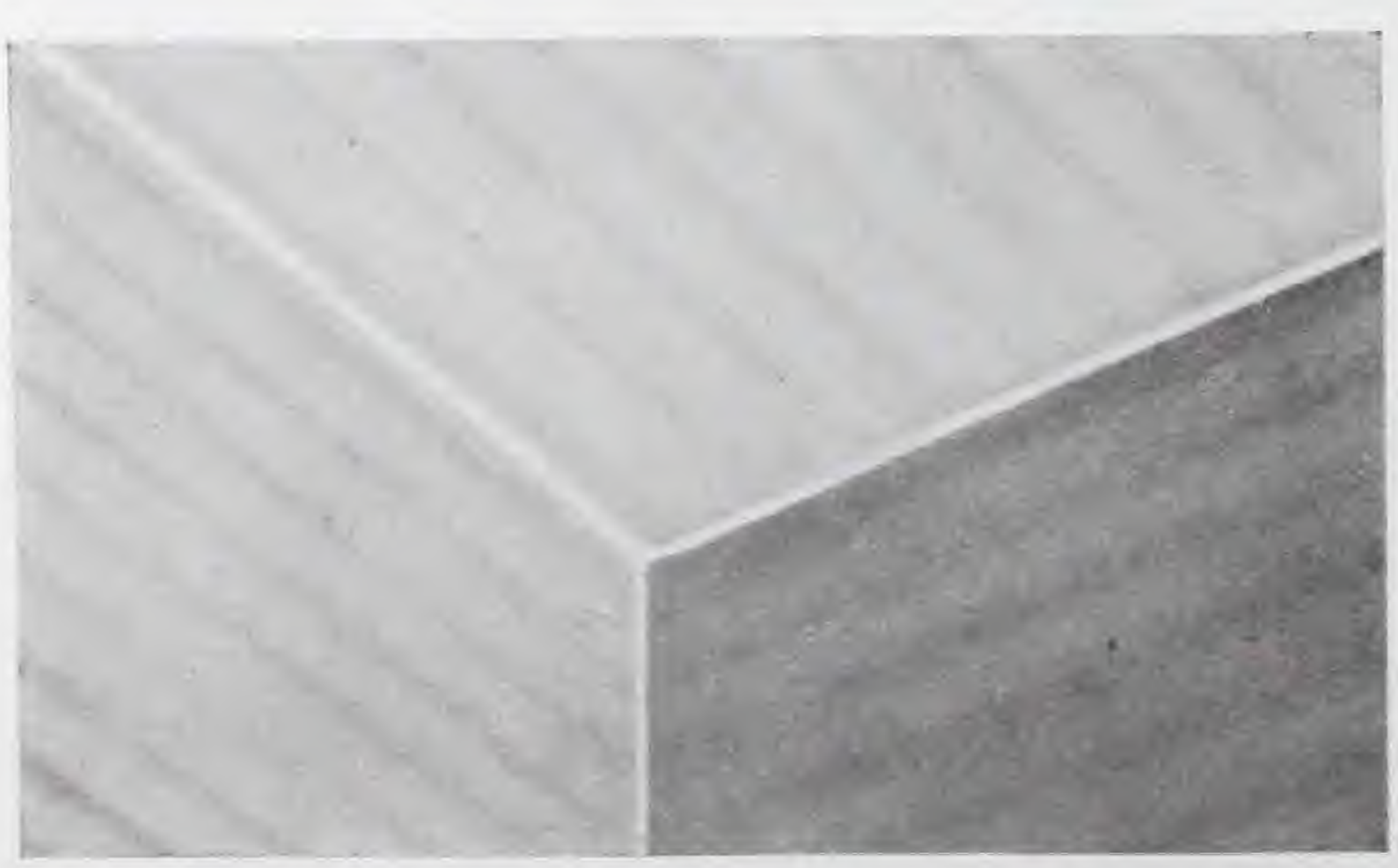
Insulation board lath are manufactured with special joints for reinforcing the plaster at the joints. The types available include the following: long edges shiplapped, galvanized wire reinforcing between framing supports; V-lap edge on the long sides, beveled on all edges; long edges tongued and grooved; beveled-shiplapped edges; and shiplapped on long edges with a 3 inch diamond mesh metal lath strip the full length of the long edge. There are also various modifications and variations of these edge treatments, but all are intended to perform the same function, namely, to reinforce the plaster at the joints between the individual lath units.

Plaster adheres permanently to insulation board lath due to the combined mechanical and suction bond. Millions of fibers protrude from the surface of the lath and when the plaster sets, an effective mechanical bond is created. A suction bond between the insulation board and the plaster is also obtained. According to laboratory tests, a direct perpendicular pull averaging 1,000 pounds per square foot is required to separate the plaster from the lath. As the plaster load of a ceiling amounts to only about 5 pounds per square foot, there is a factor of safety in the use of insulation board lath as a plaster base of about 200. This strength is greatly in excess of the strength of bond of plaster to wood lath.

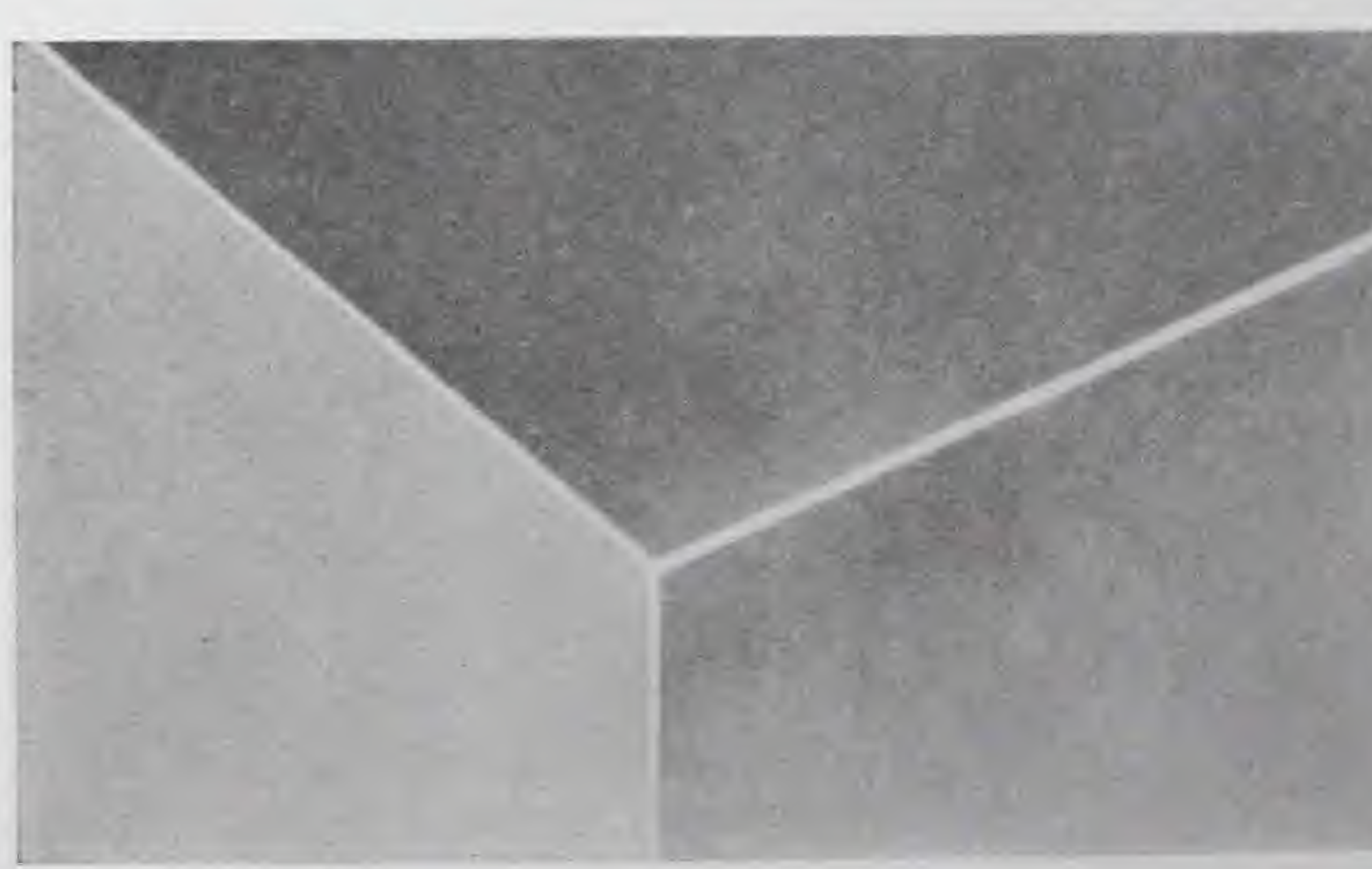
Reduces Plaster Cracks

Plastering introduces from 200 to 300 gallons of water into a house, all of which must be evaporated. When "open" lath are used much of this moisture inevitably finds its way into or between the framing members, creating unnecessary dampness between the walls. This situation is further aggravated by the droppings of wet plaster which accumulate between the studs. This is followed by a slow drying-out process of the framing members which may extend over many months, accompanied by the twisting and warping which produce plaster cracks and other faults in construction. Insulation board lath solves this serious problem because it constitutes a highly moisture-resistant barrier between the plaster and the framing. The moisture dries outward into the room and is carried away by proper ventilation.

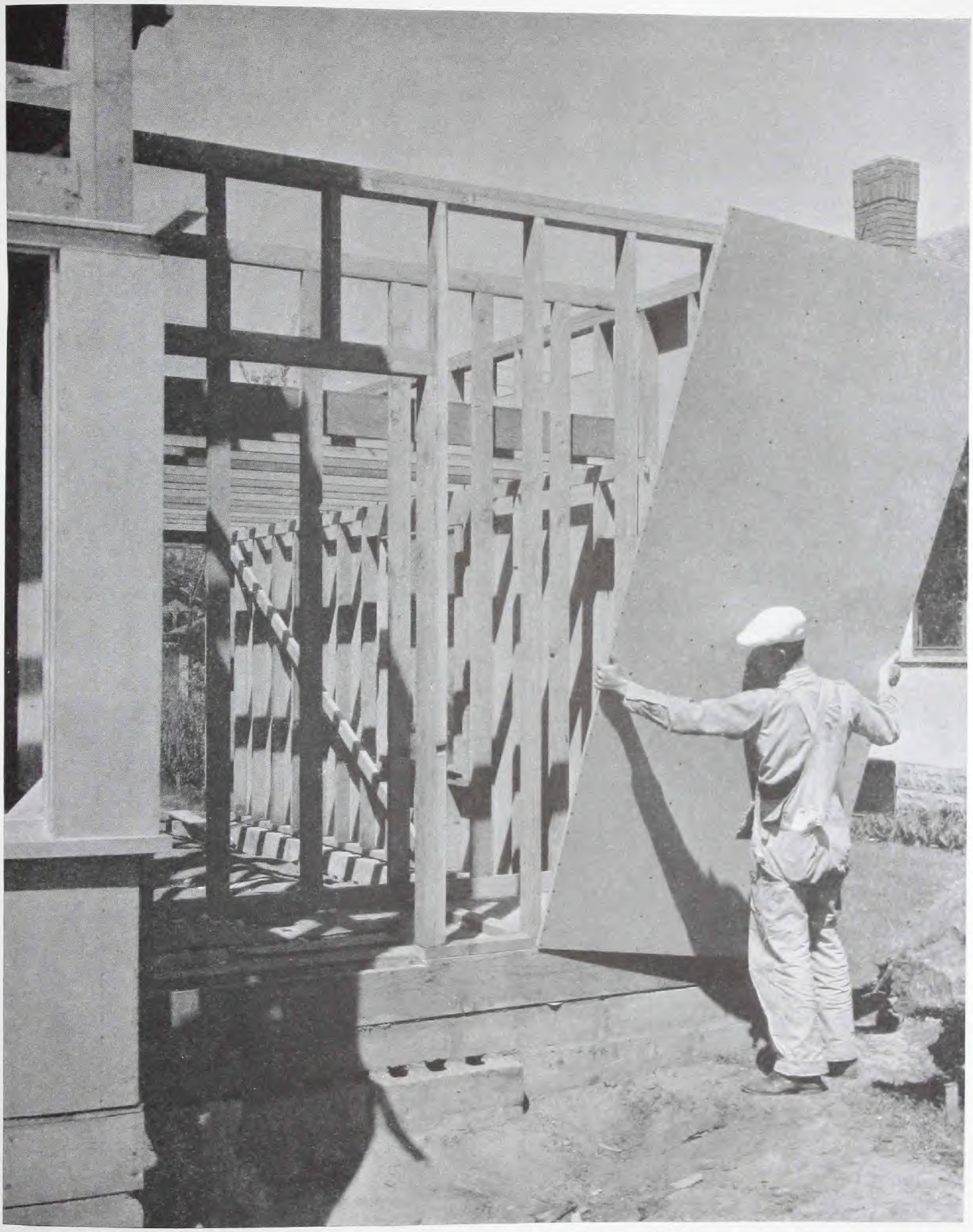
The unbroken surface of insulation board lath not only



UPPER CORNER of a room in which wood lath was used underneath the plaster. The marks are the result of moisture and dust deposit on the cooler plaster between laths.



THIS PHOTOGRAPH shows a corner of a room plastered over Insulation Board Lath. The clean, unmarked plaster results from the fact that the entire surface has a uniform warmth.



INSULATION board for wall sheathing marked with nailing spots for studs 16 inches o.c., so that workmen are helped to use enough nails and to put them in the proper places to hit the studs. Strong and well braced walls result from the use of these large sheathing units.

eliminates lath marks and minimizes plaster cracks, but, since no keys are necessary, less plaster is required for the scratch coat. This fact, plus the elimination of droppings between the studs, results in a worthwhile saving in plaster.

Flexibility and Strength

The strength and flexibility of insulation board lath permit it to be bent around arches, alcoves and circular stair walls without having to be scored or broken. This is a distinct advantage because every break in the plaster base is a potential crack in the plaster. This flexibility also acts as a safety valve when the framing starts to twist and strain. The insulation board yields and takes up the strain or pull on the nail and does not readily transmit the pressure to the plaster.

Easy to Apply

The convenient size of insulation board lath—16, 18 or 24 inches wide by 48 inches long—facilitates the application of this product by the lather.

The studs, joists and rafters should be erected as in ordinary frame construction on 12 or 16 inch centers. For exterior solid masonry walls install 1 x 2 furring strips vertically on 12 or 16 inch centers and shim to a true, level plane. Special 1⅛ inch blued plasterboard nails with 5/16 inch heads are recommended for ½ inch lath and 1¾ inch nails of the same type for ¾ inch and 1 inch lath.

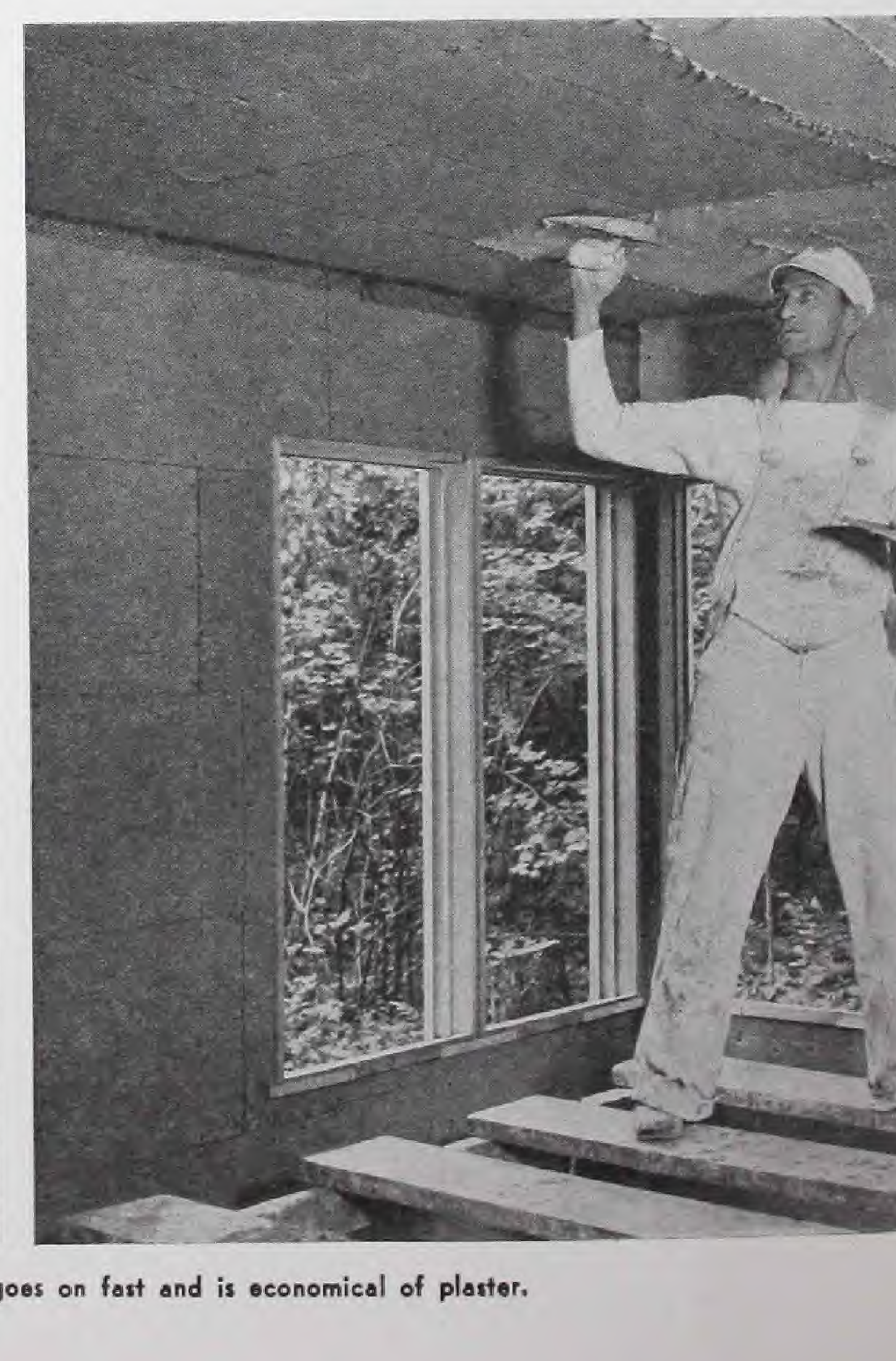
Insulation board lath should not be moistened prior to, during or after application. Lath should be applied with long edges at right angles to the framing or furring strips. Center all end joints on framing and stagger the vertical joints of each course of lath with the joints of the preceding course. Manufacturers' instructions should be followed where lath with special joints is used. Nail lath securely to framing, using five nails at each stud or furring strip; that is, twenty nails for each lath when framing is on 16 inch centers. Use strips of insulation board lath where piecing out is necessary; do not fill out with wood lath or wood strips. To cover arches, curves and sweeps, first nail lath at the end, bending it to the required contour and then nail to each successive stud, joist or furring strip.

All outside corners should be reinforced with metal corner beads. Reinforce all re-entrant angles with standard expanded metal lath strips 6 inches wide bent into the angle and secured in place by nailing. Use 6 inch strips of expanded metal lath to reinforce all joints between frame and masonry construction.

Standard gypsum cement plaster or gypsum wood fiber plaster containing no lime should be used for scratch and brown coats. Both coats should be mixed to a wet consistency to allow for application with light trowel pressure and to facilitate darbying. Any standard plaster finish may be used over the brown coat such as gypsum, lime or lime gauged with gypsum.

The plaster should be applied in three coats to full ½ inch grounds. Rod and trowel surface to a true plane. All corners and angles should be plumb and true and darby strokes should be in the direction of framing members with the darby spanning two or more studs or joists.

Provide adequate ventilation for proper drying of the plaster. Proper ventilation is necessary in winter as well as in summer. Adequate heat should be provided in winter to prevent injury to fresh plaster by frost.



PLASTERING lath of insulation board goes on fast and is economical of plaster.

Roof and Ceiling Insulation of Primary Importance

THE importance of roof and top floor ceiling insulation has become so well recognized that seldom is there any question as to the advisability of insulating at these points. And whether the roof is flat or pitched, insulation board is rapidly becoming an accepted standard for this purpose because of its economy, convenience of application and general utility.

Why Roof Insulation?

Roof and ceiling insulation is essential for several reasons. In the first place, the roof frequently constitutes the largest exposed area, especially in the case of buildings having flat roofs. Next in importance is the fact that the materials used in roof construction as a rule offer relatively little resistance to the passage of heat. Then there is the effect of the intense heat of the sun, the brunt of which must be borne by the roof structure. Insulation at this point is therefore especially important from the standpoint of summer comfort. Finally there is the indisputable fact that heat rises, making the ceiling temperature higher than the living zone temperature and having the effect of literally forcing winter heat through the top floor ceiling, attic and roof.

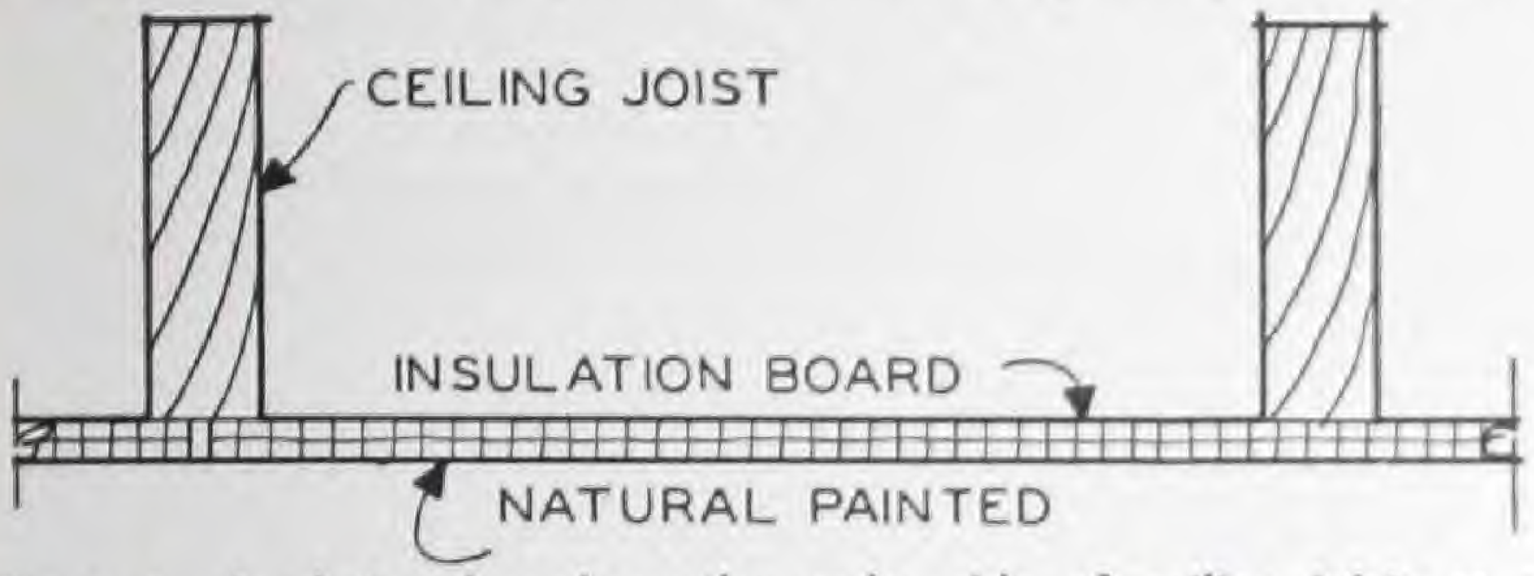


Figure 1. Insulation board on the under side of ceiling joists as a plaster base or interior finish.

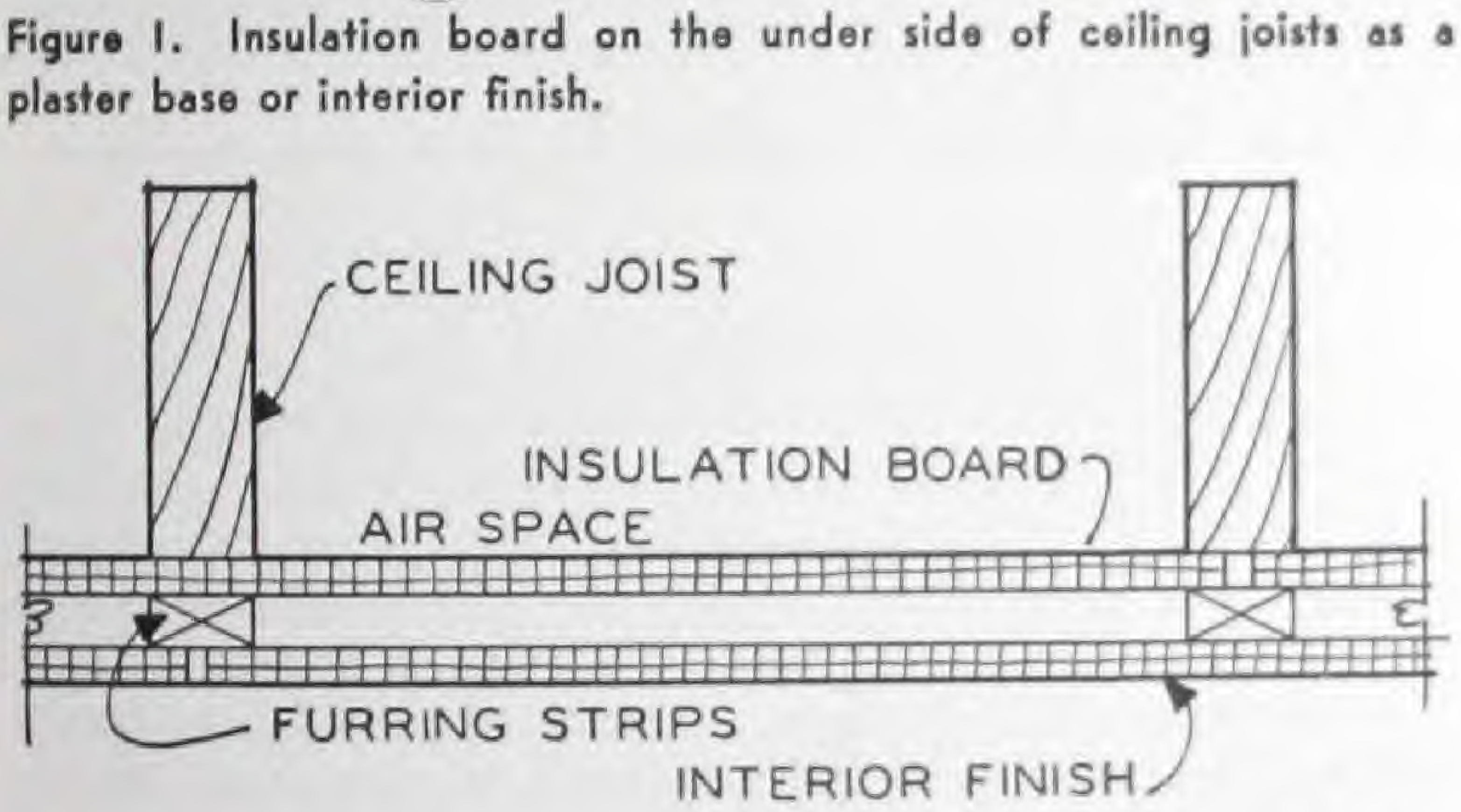


Figure 2. Insulation board on underside of ceiling joists, with furring strips over the insulation board, and interior finish of insulation board or other materials on furring strips.

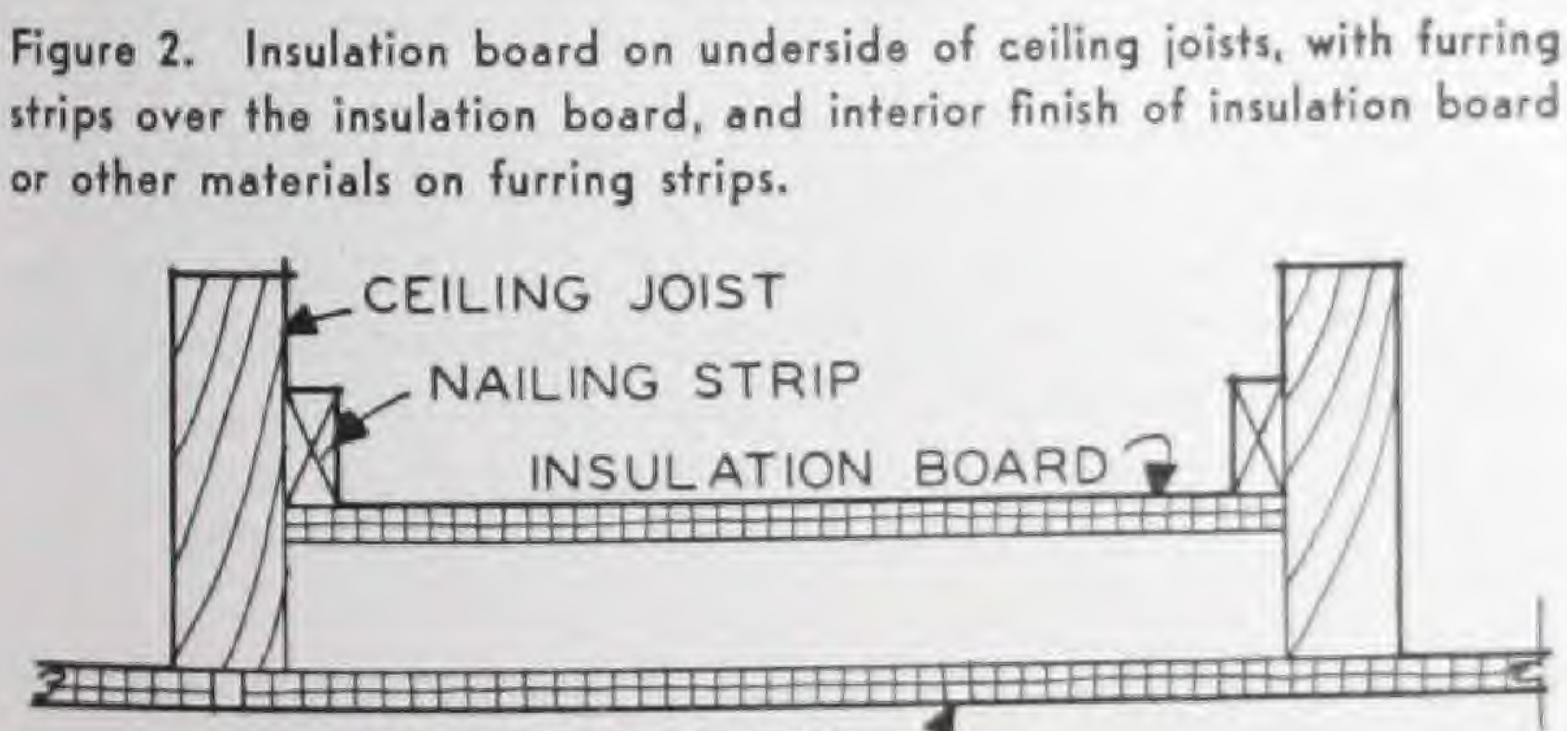


Figure 3. Insulation board between ceiling joists, with interior finish of insulation board or other materials on underside of joists.

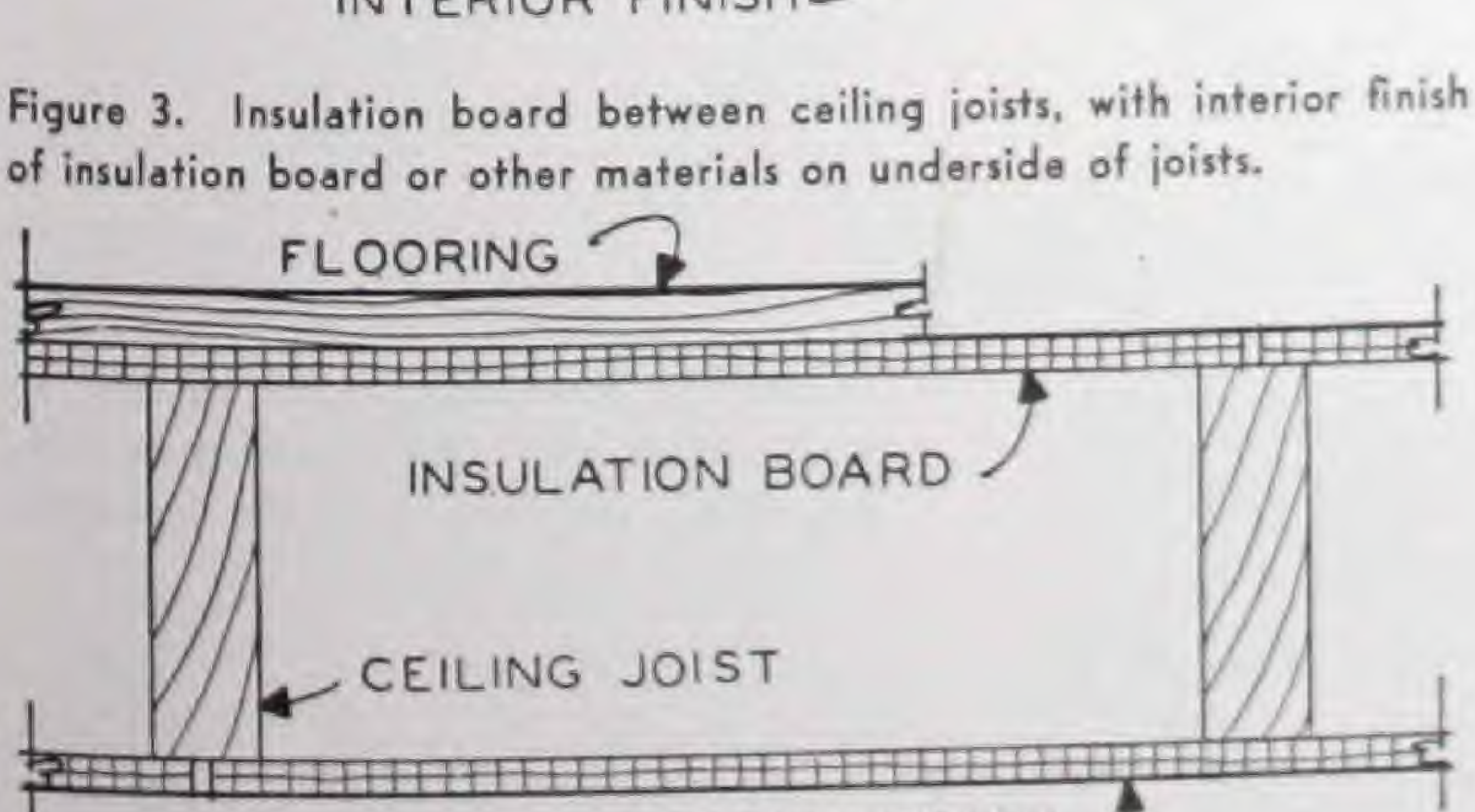


Figure 4. Insulating board on top of ceiling joists, with or without flooring with interior finish of insulation board or other materials. (Note: Flooring must be applied over insulation board where attic floor is to be used.)

Where to Insulate

Roofs may be insulated at either the ceiling or the roof structure, or both. Many heating engineers prefer to place all the insulation in the ceiling. Others prefer to divide the insulation between the ceiling and roof to obtain a more balanced condition, claiming that ceiling insulation alone tends to induce extremely cold attics which must be ventilated to prevent moisture from accumulating in the attic as condensation or frost. Still others believe that the best place to install the insulation in most cases is in the roof structure.

The correct answer depends somewhat on individual circumstances. Therefore a single hard and fast rule to cover all conditions would not be possible. The more common practice is to insulate pitched roofs either by dividing the insulation between the roof and ceiling or by placing it all in the ceiling. With flat roofs, the usual practice is to install the insulation over the roof deck and under the roofing, but in some instances all or part of the insulation is installed in the ceiling.

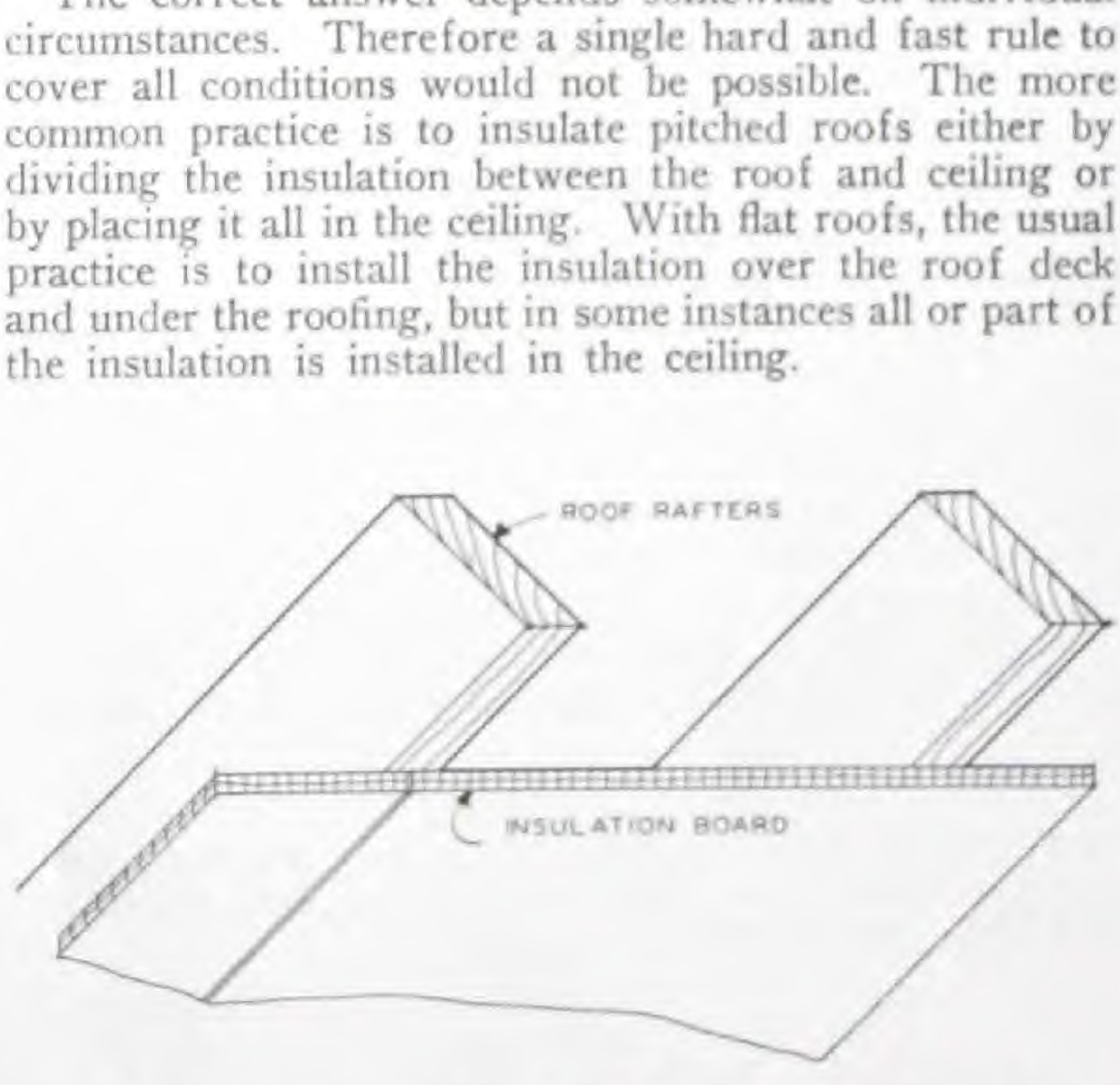


Figure 5. Insulation board on underside of roof rafters as attic lining.

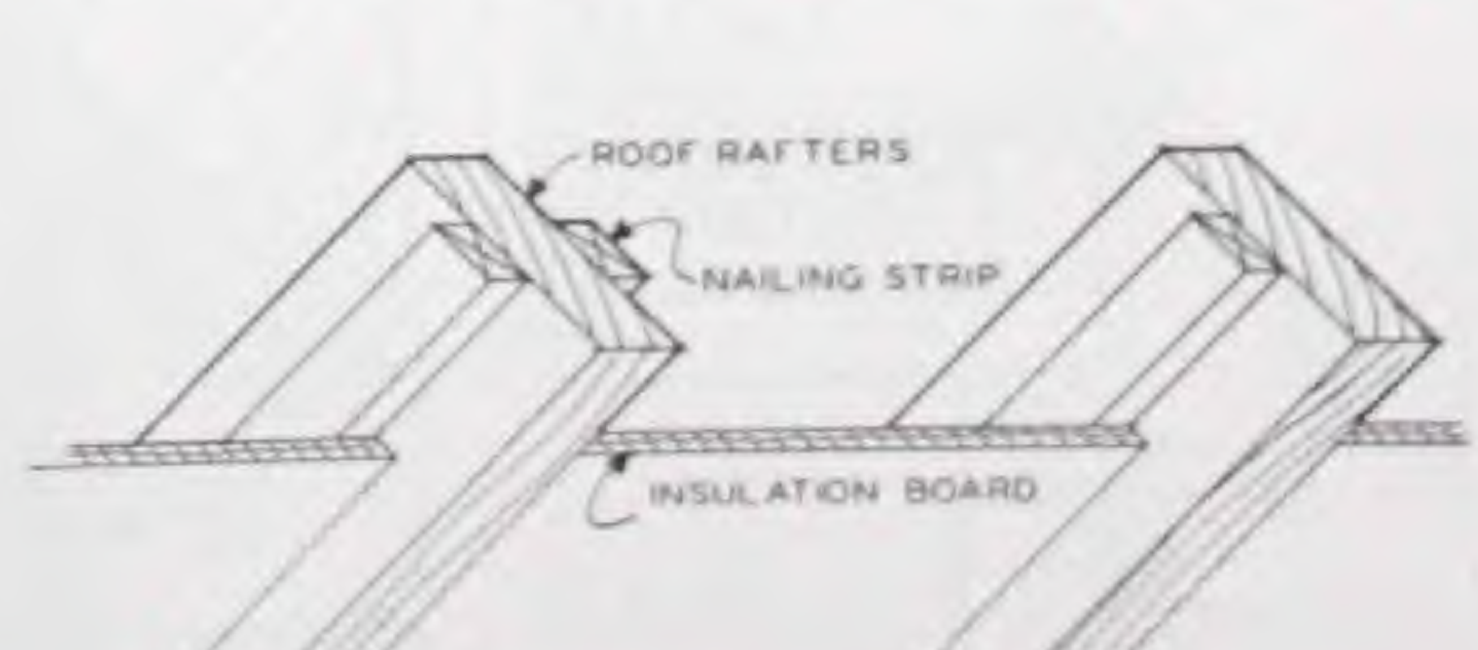


Figure 6. Insulation board between roof rafters, nailed to wood strips.

ROOF INSULATION Board being applied in two layers in hot asphalt on large industrial plant at Ottawa, Ill.; C. R. Dick, Architect.

Pitched Roofs

In the case of pitched roofs there are many places in the ceiling or roof where insulation board may be installed. The accompanying Figures 1 to 8 inclusive illustrate these applications.

Figure 1 shows insulation board applied to the under side of the ceiling joists either as a plaster base or as interior finish. In Figure 2 the insulation is applied in the same location as in Figure 1, the large board being used in this case, but furring strips installed over the face of the insulation board and the finished ceiling then applied to these strips. This finished ceiling may consist of another layer of insulation board of either the interior finish or plaster base type, or of ordinary lath and plaster.

In Figure 3, the insulation board is shown between the ceiling joists, cut to size and nailed to wood strips. The exposed finish may be the same as in Figure 1. The fourth location for the insulation board is on top of the ceiling joists as shown in Figure 4. The insulation board should be covered with wood flooring if the attic floor is to be used. Figures 5 and 6 show the insulation board applied respectively to the underside of the roof rafters as attic lining, and between the roof rafters, nailed to wood strips.

Where insulation board is to be applied directly to roof rafters of pitched roofs (Figure 7) either the wall sheathing or building board may be used. The boards should be applied lengthwise and directly to all framing members with ample bearing for nailing along all edges. Nail to

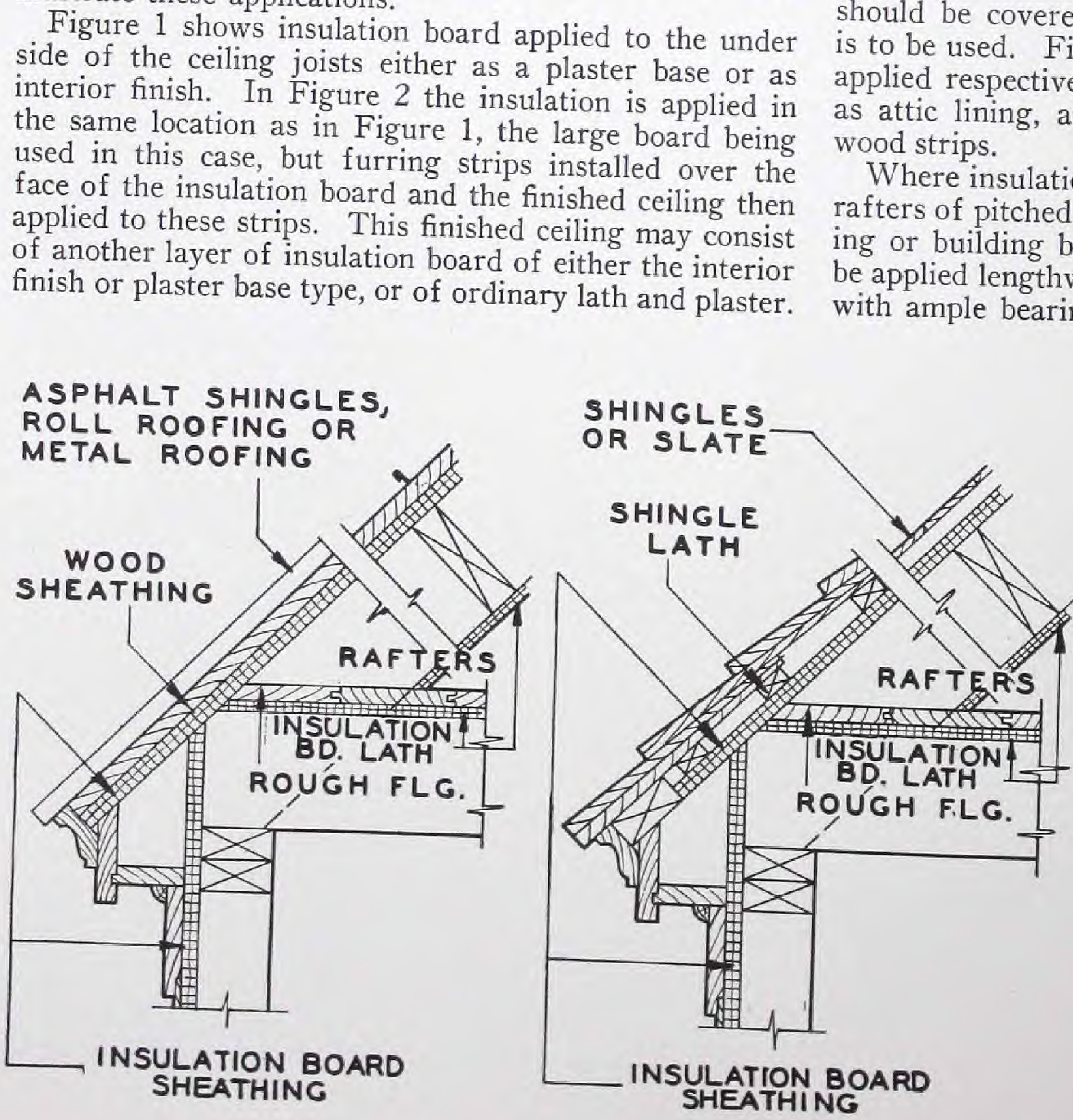


Figure 7. Insulation board on top of roof rafters with roof sheathing or nailing strips (roofers) over the insulation board.

ROOF INSULATION board is often used in thick built-up units with interlocking joints.

intermediate framing members first, spacing nails 6 inches apart, and then along all edges, spacing nails 3 inches apart and 3/8 inch from edges. Wood sheathing or wood strips (roofers) to which the roofing is to be secured should be applied directly over the insulation board, driving nails through to the rafters. Roofing should be applied to the sheathing or wood strips in accordance with manufacturers' specifications.

Where insulation board is to be applied over continuous wood surfaces as in Figure 8, either the building board, wall sheathing or the smaller roof insulation units may be used. Each board should be secured in place by nailing along each edge and staggered along the longitudinal center line, spacing nails 12 inches apart. Roofing may be applied over the insulation board or to wood strips as indicated in Figure 8, following the manufacturers' instructions.

Much of the preceding discussion relative to pitched roofs, particularly that referring to top floor ceilings, applies also to flat roofs, the essential difference being in the application of the insulation to the roof deck. Roof insulation intended specifically for application over flat roofs is supplied in small units, usually about 22 x 47 inches and is available in thicknesses of 1/2, 1, 1 1/2 and 2 inches or more. This roof insulation board is applied to wood roof decks by nailing directly thereto or over a layer of roofing felt or resin-sized building paper. Where high humidities are to be maintained in the building, it is customary to apply a vapor cut-off over the roof deck before installing the insulation. This vapor cut-off usually consists of saturated roofing felt nailed to the roof deck. Subsequently, the roof insulation is stuck to the felt with a mopping of hot asphalt.

Roof insulation board is applied to concrete, gypsum, unit tile and steel roof decks by imbedding the insulation units in a mopping of hot bitumen. The insulation is then covered or waterproofed by means of alternate courses of saturated roofing felt and hot pitch or asphalt.

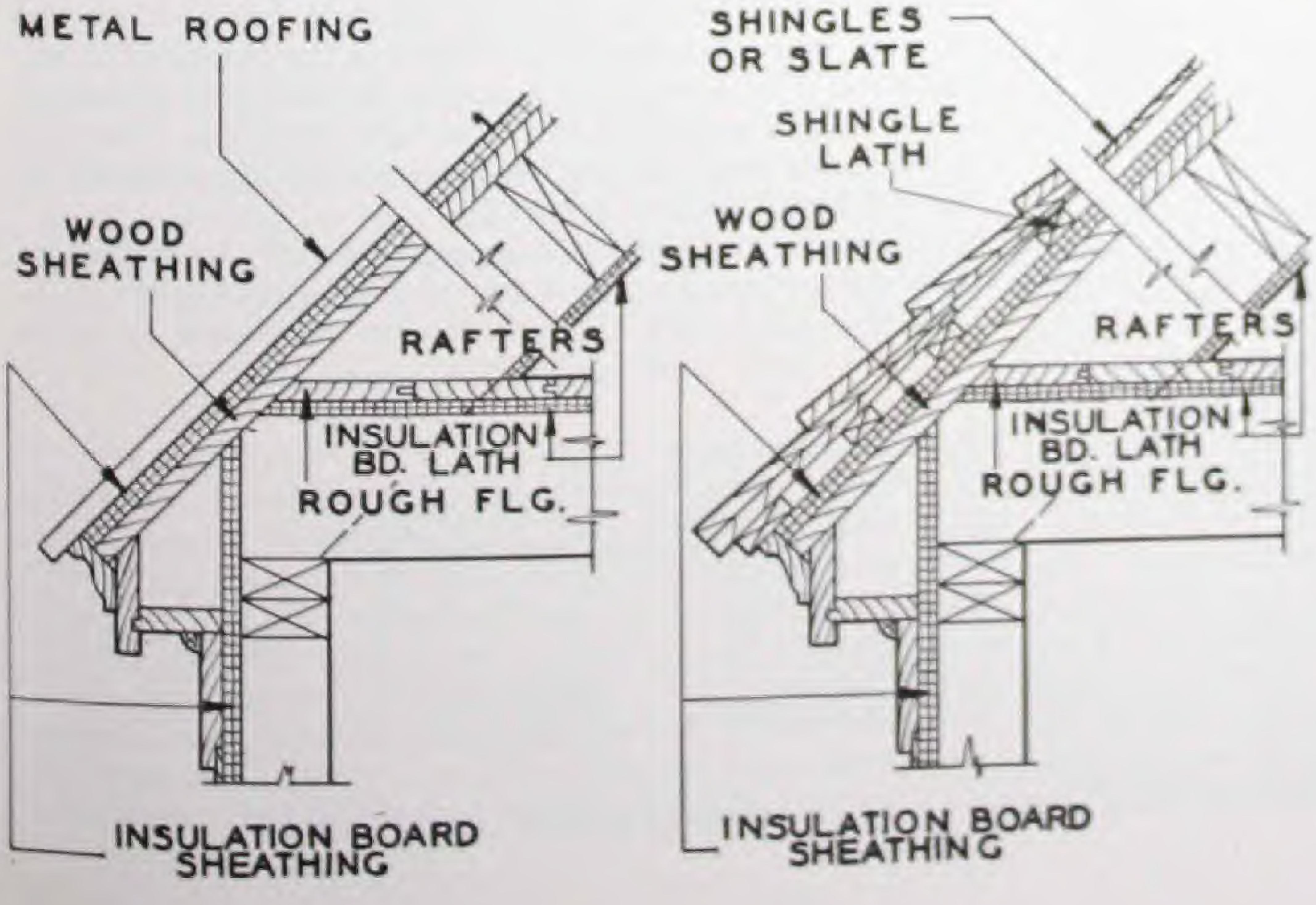


Figure 8. Insulation board over wood sheathing.

Heat Insulation Facts and Figures

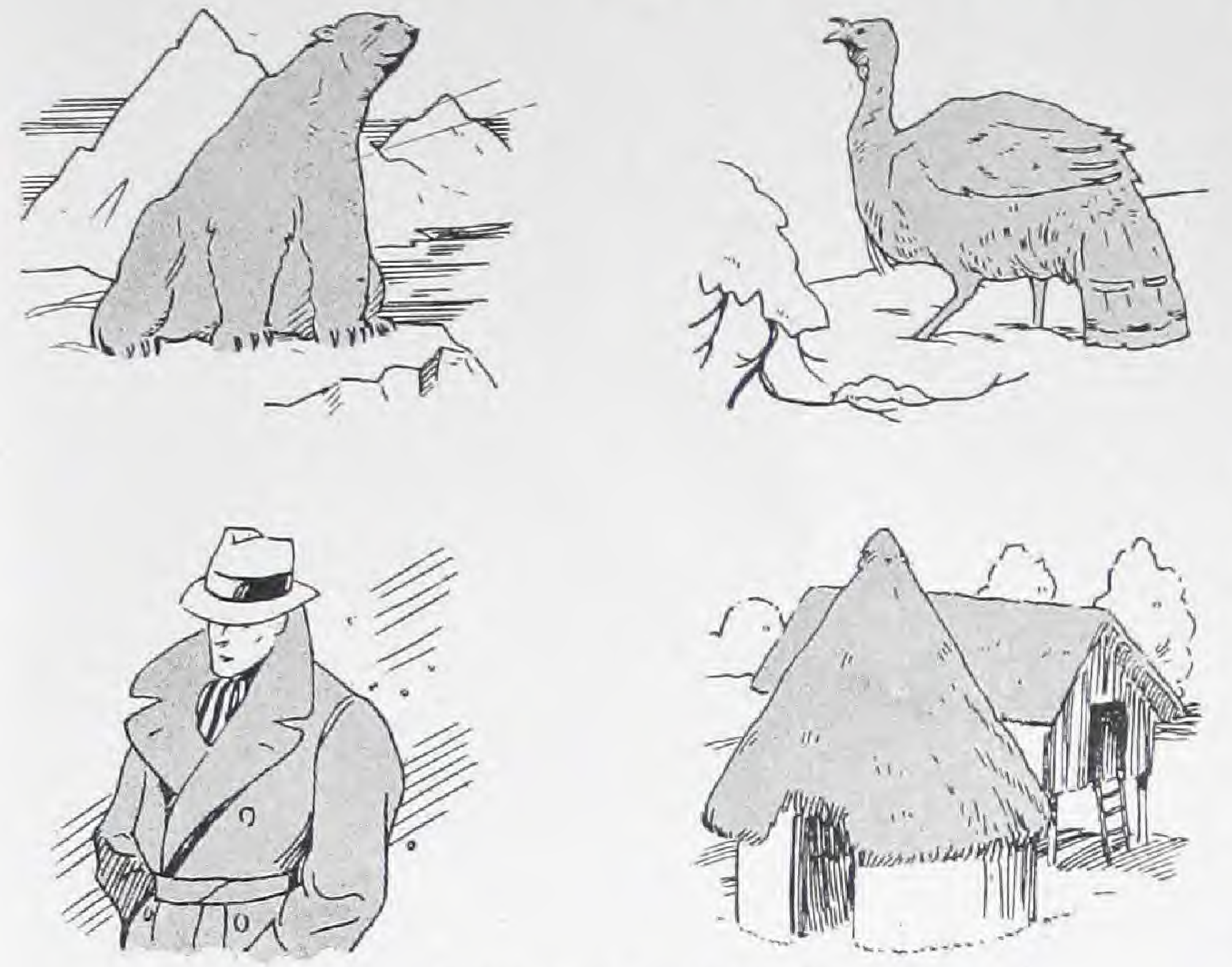


FIGURE 1. Examples of insulation in nature.

WHAT is an insulation—a *heat* insulation?

A heat insulation is a material having a high degree of heat and wind resistance and which when installed in a wall effectively retards or prevents the passage of heat through the wall. A smaller amount of heat will therefore pass through an insulated wall during any period of time than during the same period if the wall were not insulated. Consequently, less fuel will be required in the winter to maintain the desired temperature, and the room or building or space involved will be cooler in the summer, or if cooled by refrigeration, less refrigeration will be required to cool the space.

How about "cold" insulation? Strictly speaking, all insulations of this type are *heat* insulations and are so called because cold is simply the absence of heat. In either case, winter or summer, the object is to prevent heat from passing through the wall. In the winter it keeps the heat in and in summer it keeps the heat out.

Insulation Idea Not New

The principle of insulation is as old as creation. There are many examples of insulation in nature. Fur is one of the best insulations known; hence fur-covered animals may be considered to be insulated. If it were not for the fur covering of the polar bear he could not withstand the cold blasts of the arctic regions, sleep on ice floes and bathe in icy water. Feathers provide a degree of insulation and therefore birds are insulated.

The insulation idea is the main reason for wearing clothing. Judging from modern abbreviated swimming suits, modesty is no longer an impelling factor. The purpose of clothing during cold weather is really to prevent heat from escaping from the body. The body can be kept warm with its own heat if it is properly "insulated." Of course, in the warm weather, we wear less "insulation" in the form of clothing because we want the body heat to escape.

Even insulated dwellings are really not new. The thatched hut of Northern Europe was for all practical purposes insulated because it was built with walls of clay and stone several feet thick and with a correspondingly thick straw roof. The stone castles of the middle ages might be considered insulated because of the thickness of the walls, although stone is not ordinarily considered to be an insulating material for reasons which will be explained later. The Spanish mission houses of the southwest desert, where the temperature sometimes rises to 140 degrees in the daytime were amazingly cool because they also had thick walls built of clay and stone.

Commercial Insulation

These dwellings were insulated mainly because they had thick walls rather than because of the materials used. Now a commercial insulation is such because it has a high degree of heat resistance per unit of thickness. In other words, a commercial insulation is in a sense "concentrated" insulation because an inch of such a material will do the work of perhaps several feet of certain hard, dense materials.

Commercial insulations are frequently classified as (1) rigid or structural, (2) semi-rigid, (3) flexible, (4) fill and (5) reflective insulations. Insulation board comes under the classification of rigid fibrous or structural insulation.

Conductivity

Now the rate at which heat flows through a material is called its *conductivity* and this is simply the number of Btu's (British thermal units) that will pass through one square foot of the material one inch thick in one hour when there is one degree temperature difference between the two surfaces. The average conductivity of insulation boards of production-line dryness is 0.33, which means that about 1/3 of a Btu will pass through one square foot an inch thick in one hour for a one degree temperature difference between the two surfaces. By way of comparison, concrete has a conductivity of 12, which means that heat will pass 36 times more rapidly through concrete than through insulation board, thickness for thickness. The conductivities of most building and insulating materials are given in reference volumes such as the Guide of the American Society of Heating and Ventilating Engineers.

Heat Transfer Coefficients

If one is to be familiar with this subject, there is another unit to be taken into consideration, namely, the *heat transfer coefficient*. This is similar to conductivity but instead of referring to a single material it has to do with the rate of heat transfer through a compound wall or roof and may therefore involve a combination of materials. This unit is very useful to the heating man in computing the heat losses through the walls, roof and other parts of a building for the purpose of estimating the size of heating plant required.

In order to illustrate the meaning and significance of this unit, consider the ordinary frame wall without insulation which has a heat transfer coefficient of about

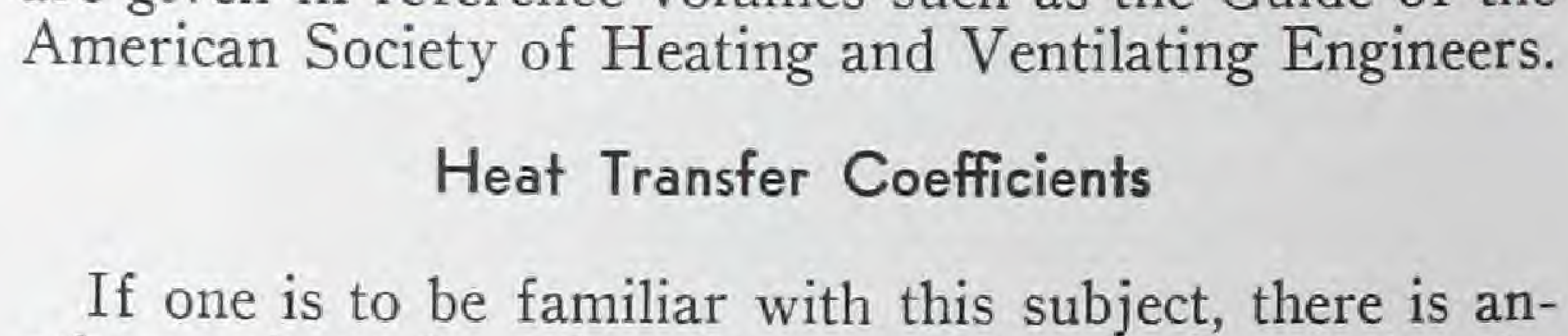


FIGURE 2—Methods of heat transfer

0.26. This is the number of heat units (Btu) that will pass through a square foot of the wall in one hour for each degree temperature difference on the two sides. If the average temperature difference is 30 degrees, the amount of heat transferred will be 30 times 0.26 or 7.8 Btu and if the net wall area is 1,000 square feet, the heat loss will be 7.8 times 1,000 or 7,800 Btu per hour. If instead of one hour, there are 5,000 hours in a heating season, the heat loss through this 1,000 square feet will be 5,000 times 7,800 or 39,000,000 Btu.

Probably it will mean nothing to the average individual to say that 39,000,000 Btu will pass through (and thus be lost) 1,000 square feet of uninsulated wall area during the heating season, but if this quantity is translated into tons of coal it will be more readily understood.

Coal has an average heat content of about 13,000 Btu per pound, but because it isn't possible to utilize all the heat in the coal, due to unburned fuel and other factors, it is necessary to make an allowance. Let's say that the efficiency of combustion in this case is 60 percent. Therefore, we will get 60 percent of 13,000 or 7,800 Btu out of each pound of coal.

Now the 39,000,000 Btu lost through the 1,000 square feet of wall previously referred to would be equivalent to $\frac{39{,}000{,}000}{7{,}800}$ or 5,000 pounds of coal. This in turn divided by 2,000 to change to tons, represents a fuel requirement of 2½ tons of coal to replenish the heat lost through this 1,000 square feet of wall area. Of course, much more fuel, perhaps 7 or 8 tons—will be required to take care of all of the heat lost through other parts of the building in order to maintain the desired temperature.

Fuel Saving

Suppose instead of uninsulated construction, insulation board were used for sheathing and plaster base. What would be the fuel saving? The heat transfer coefficient in this case would be about 0.15 if ½ inch insulation board were used for plaster base and 25/32 inch for sheathing. Using this coefficient instead of 0.26 for the uninsulated wall and making the same calculations, the fuel required for the 1,000 square feet of wall area under the same conditions will be $\frac{0.15 \text{x} 30 \text{x} 5{,}000}{13{,}000 \text{x} 0.60 \text{x} 2{,}000}$ or 1.45 tons.

Thus there is a saving of over a ton of coal per heating season for the 1,000 square feet of wall area under consideration. If the total net wall area were 2,000 square feet the saving would be over 2 tons of coal whereas if the roof or top floor ceiling were insulated there would be an additional saving. These calculations show how it is possible to determine the fuel saving due to insulation in any given case. The heat transfer coefficients for all common types of construction are also given in engineering handbooks, or they may be calculated by means of a simple formula when the conductivities of the materials used in the construction are known.

Reduction in Heating Plant Size

It is apparent that if less fuel is required to heat the building, a smaller heating plant or less radiation (if this type of heating is used) will suffice. In arriving at the heating plant size, the heating engineer calculates the heat loss for the entire building for one hour during the coldest weather and selects a heating plant of sufficient capacity to supply this heat loss. By using insulation board throughout, the heat loss may be reduced sufficiently to permit the use of a smaller sized heating plant or less radiation. For example a building may have a heat loss

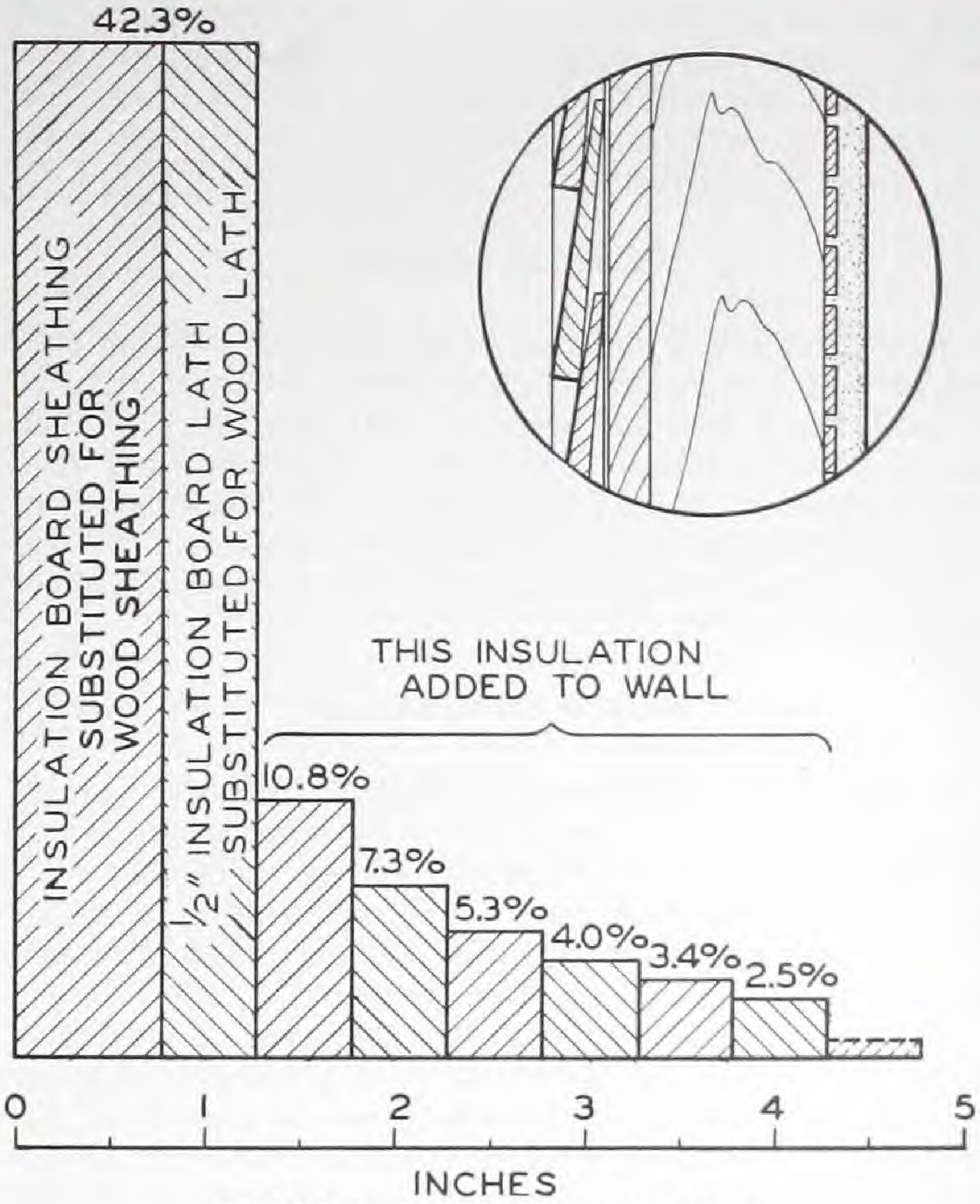


FIGURE 3. Diminishing returns chart

without insulation of say 100,000 Btu per hour, and only 70,000 Btu per hour if insulation board is used. If a certain heating plant is made in two sizes, namely 120,000 Btu and 80,000 Btu, it would obviously be possible to use the smaller size in the case of the insulated structure, which would undoubtedly represent a satisfactory saving in cost. But regardless of whether advantage is taken of the reduction in the size of the heating plant, there will be an annual fuel saving which will continue as long as the building is used and heated.

Diminishing Return

An important insulation principle is known as diminishing return. In every day language, this means that the first inch of insulation saves the most fuel, the next inch less, the third inch still less, and so on. So it is apparent that the first inch of insulation is the best investment because it does the most good—it saves the cream, so to speak, while the remainder to be saved is, figuratively speaking, skimmed milk.

This fact can best be illustrated by the accompanying chart. By using insulation board sheathing (25/32 inch) and plaster base (½ inch) in place of other sheathing and lath, there is a saving of 42.3 percent of the heat that would otherwise pass through the wall. Now suppose another half inch of insulation were added; there would be an additional saving of 10.8 percent. The next half inch would save an additional 7.3 percent, the next 5.3 percent and so on. The total additional saving of six half inch layers (3 inches) is 33.3 percent. Although the first 1¼ inch of insulation used in place of other materials saved 42.3 percent, the next three inches (which did not replace any materials) saved only 33.3 percent additional.

These figures do not apply to the building as a whole, but to the wall only, and are introduced simply to illustrate the principle of diminishing return. So far as the entire building is concerned the percentages would be about ¼ or 1/3 of the figures given above, since the heat

loss through the walls usually represents from ¼ to 1/3 of the total. Let's take 1/3. The sheathing and lath would then save about 14.1 percent of the total heat loss whereas the additional three inches would save only 11.1 percent additional.

Insulation Required

Insulation board sheathing and lath will provide sufficient wall insulation for all ordinary requirements. If desired, the 1 inch lath may be used instead of ½ inch where additional wall insulation is warranted, and this, plus an inch or an inch and a half of insulation board in the ceiling and/or roof, plus storm windows, will provide a well-insulated structure, suitable for any type of fuel—coal, oil or gas.

Surface Condensation

Condensation of moisture on interior surfaces of buildings, particularly ceilings, is often a serious problem. It is caused by moisture-laden air coming in contact with cold wall or ceiling surfaces. This condensation or sweating can be prevented by installing the correct thickness of insulation in the wall or roof structure.

In order to arrive at the proper thickness of insulation board to prevent condensation, it is necessary to know the relative humidity and temperature of the air in the building, the wall or roof construction and the lowest outside temperature likely to be encountered in the locality. Using these data and referring to charts furnished by insulation board manufacturers, it is a simple matter to arrive at the amount of insulation necessary to stop the "sweating."

Air Conditioned Buildings

Air conditioning involves among other things, humidification and heating in the winter and dehumidification and cooling in the summer.

In the winter the introduction of additional moisture into the building may present certain condensation problems. In industrial buildings where exceptionally high humidities are sometimes maintained, ceiling condensation frequently becomes a serious problem. This can be overcome by the use of the proper thickness of insulation board applied to the roof structure.

Surface condensation, so far as walls and ceilings are concerned, is not a problem in humidified residences, if insulation board is used in the walls and ceiling. Condensation on windows, however, is quite common and can be prevented by means of storm windows or by reducing the humidity in cold weather.

The amount of insulation required for winter air conditioned buildings is in general the same as for winter heating, except so far as additional insulation is required to prevent condensation, as already indicated.

In the summer, condensation is not usually a problem in air conditioned buildings. While it might appear that a greater thickness of insulation would be justified where summer cooling is used, because of the higher cost of refrigeration as compared to heating, practically this is not so. Actual calculations to determine the economic thickness of insulation for summer cooling indicate that approximately the same thickness as for winter conditions will suffice.

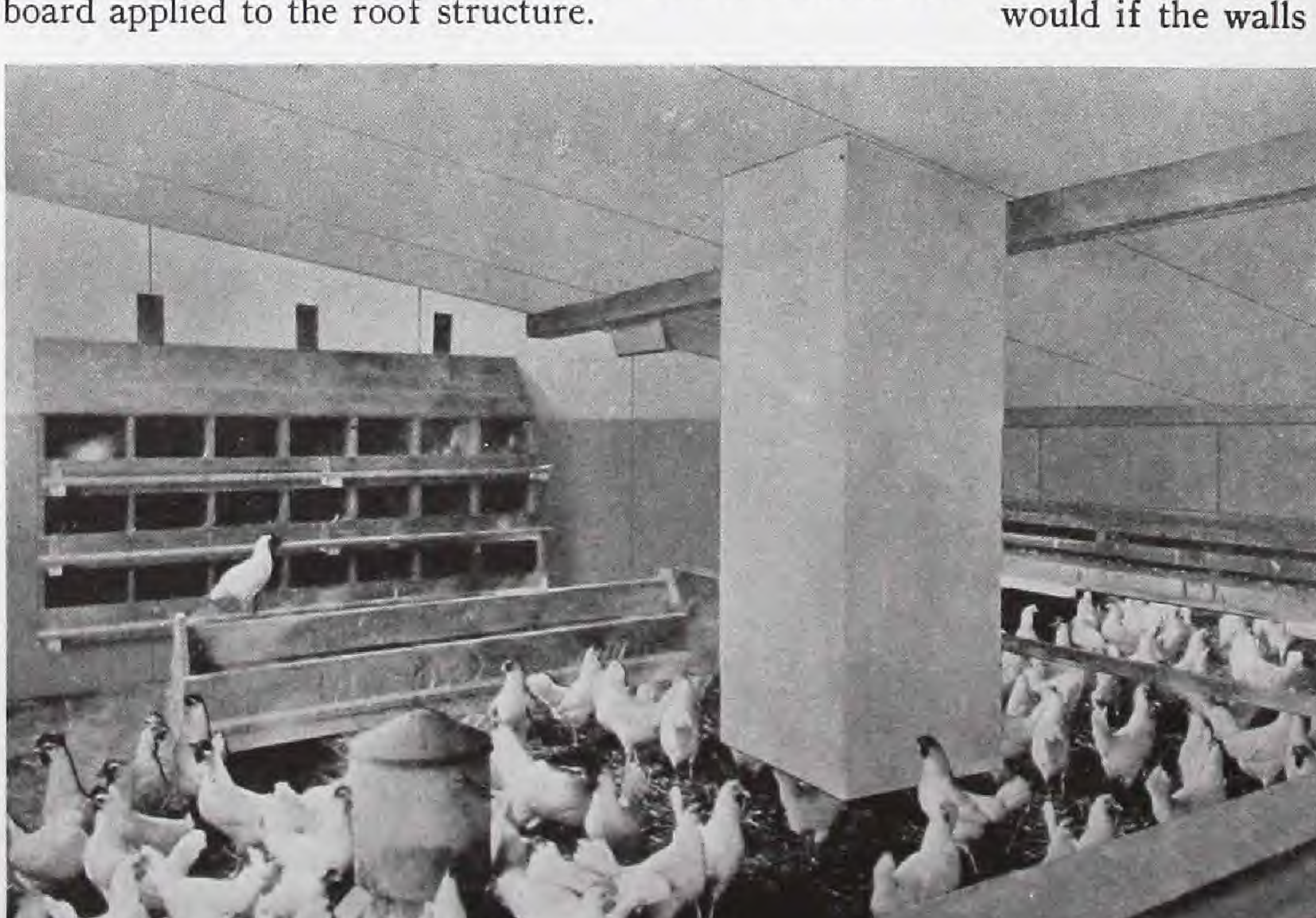
Summer Comfort

Insulation board definitely reduces summer air temperatures in buildings by reducing the rate of heat flow through the wall and roof structure. However, without mechanical cooling it is not possible to predetermine the exact number of degrees of cooling which will be produced by a given thickness of insulation board.

The value of insulation board can be most accurately stated in terms of the percentage of heat kept out. For example, the insulation board sheathing and ½ inch lath previously referred to would keep out 42.3 percent of the heat that would otherwise pass through the wall. This, of course, is the same as the percentage of heat that would be retained in the cold weather because the efficiency or effect of the insulation is the same regardless of which way the heat travels.

Insulation board has another effect on comfort. It lowers the surface temperature of the walls in the summer and this has an indirect effect on the sensation of warmth, because the hotter the walls, the warmer one feels. Consequently, the cooler walls due to insulation board, help to increase the sensation of coolness.

In the winter this phenomenon has the reverse effect. The walls are warmer when insulation board is used and hence the occupants of the room feel warmer than they would if the walls were cold.



INSULATION Board is highly regarded by poultrymen; assures warm, dry hen houses.

Sound Conditioning with Insulation Board

THE subject of sound conditioning as it relates to insulation board is divided into four separate and distinct phases. The first is sound insulation or the prevention of sound transmission through walls and floors, the second is architectural acoustics or the improvement of hearing conditions in auditoriums, the third is sound quieting or the reduction of noises in offices, shops and restaurants, and the fourth is machinery insulation or the control of machinery noises. It is the purpose of this article to submit practical suggestions for the control of sound by means of insulation board rather than to enter into a technical discussion of the theory of sound and sound transmission.

Sound Insulated Partitions

To meet the requirement of good sound insulation construction a partition or floor separating two rooms is expected to act in such a way that sound created in one room shall not be loud enough to be heard in the other room, or, if heard at all, shall not be markedly disturbing.

Four types of sound insulating partitions are illustrated in the accompanying figures. In the furred sound insulating partition shown in Figure 1, the studs are spaced on 16 inch centers and a double layer of insulation board applied to each side with furring strips between as indicated. Uniform, straight studding should be selected. The staggered stud sound insulating partition, consisting of insulation board lath, and plaster, on both sides, is shown in Figure 2.

An efficient sound insulating partition involves the double stud construction shown in Figure 3. A double row of 2 x 2 studding, or 2 x 4 studding with the long dimension parallel to the face of the partition, should be spaced on 12 or 16 inch centers and nailed to 2 x 6 sills. A layer of insulation board is nailed between the double row of framing to further increase the sound insulating efficiency. This type of partition is not recommended for load-bearing purposes.

The auxiliary partition shown in Figure 4 illustrates a method of sound insulating existing partitions. A free standing auxiliary partition is erected on one or both sides of the existing wall, the 2 x 2 studding being placed on 12 or 16 inch centers. The addition of a layer of insulation board nailed between the old and new portions improves results. Partitions consisting of plain 2 x 4 studding with insulation board nailed directly to both sides, are not recommended where high sound insulating properties are desired.

Sound Insulated Floors

The sounds transmitted by floors are either air-borne sounds, such as those of speaking, or sounds having their origin in some physical impact such as walking or the moving of furniture. Air-borne sounds seldom pass through floors to such an extent as to be of annoyance to the occupants of the room below or above the floor, due to the fact that floors are usually heavier, for structural reasons, than walls. Sounds due to physical impact are usually the most serious floor problem.

The simplest way to insulate masonry floors against impact sounds is to deaden the sound at the source. This is accomplished by the use of ½ or 1 inch insulation board placed on top of the masonry and covered with a

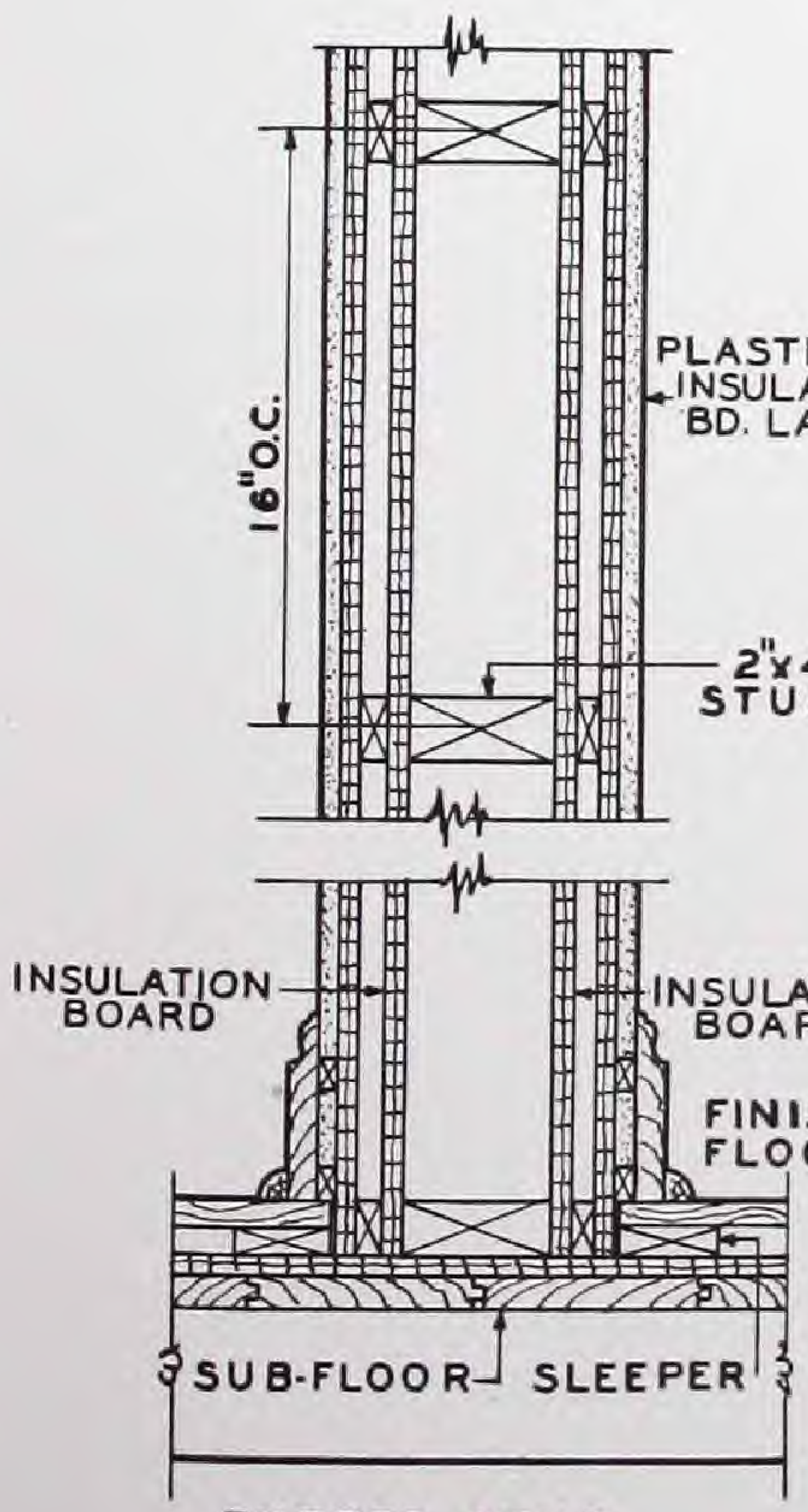


Figure 1.
Furred stud construction.

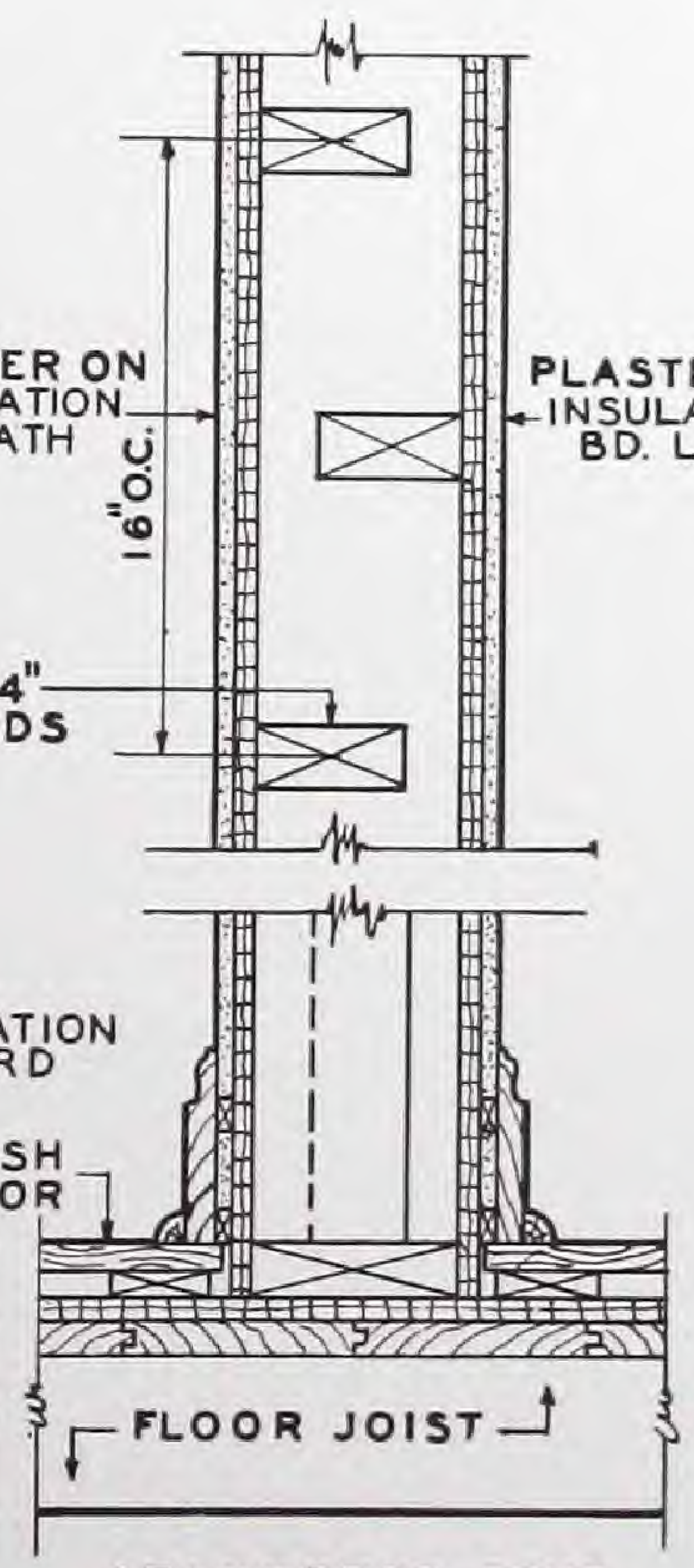


Figure 2.
Staggered stud construction.

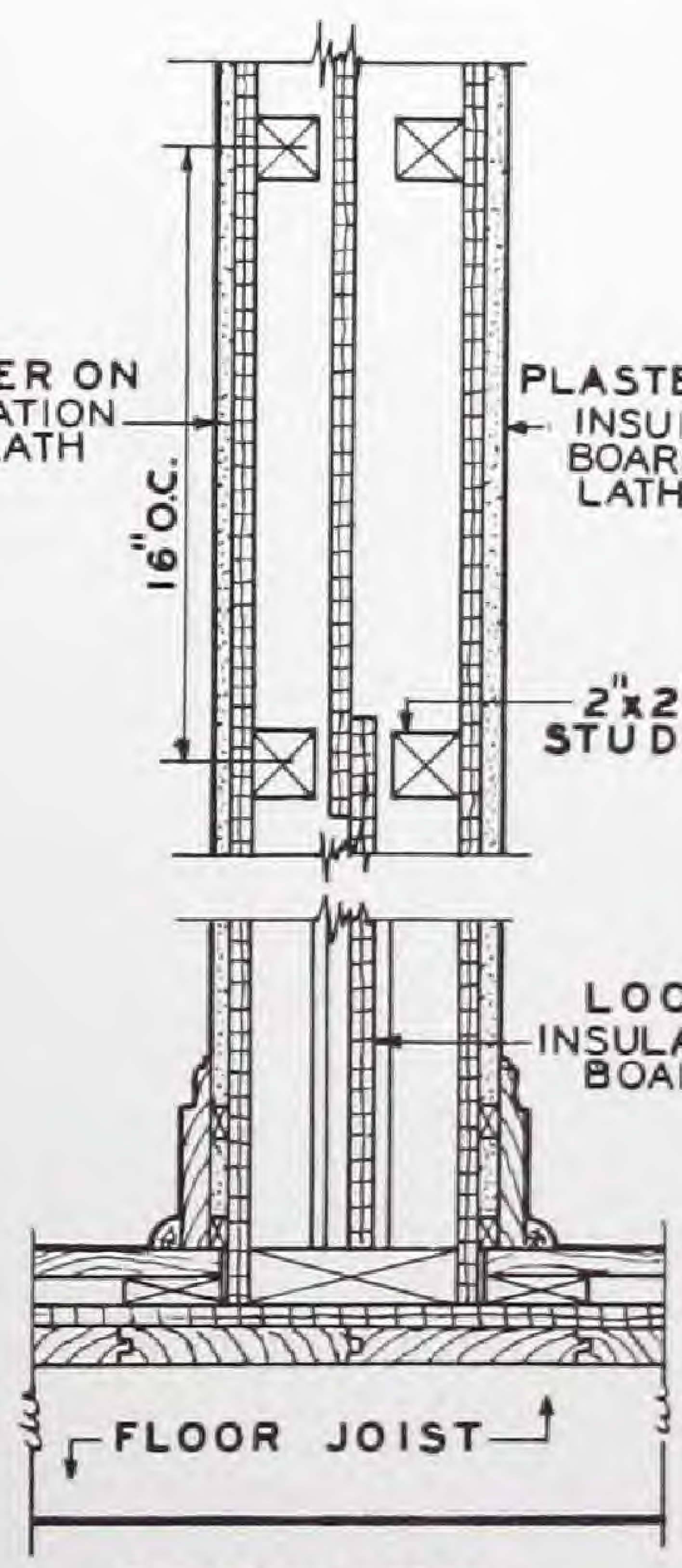


Figure 3.
Double stud construction.

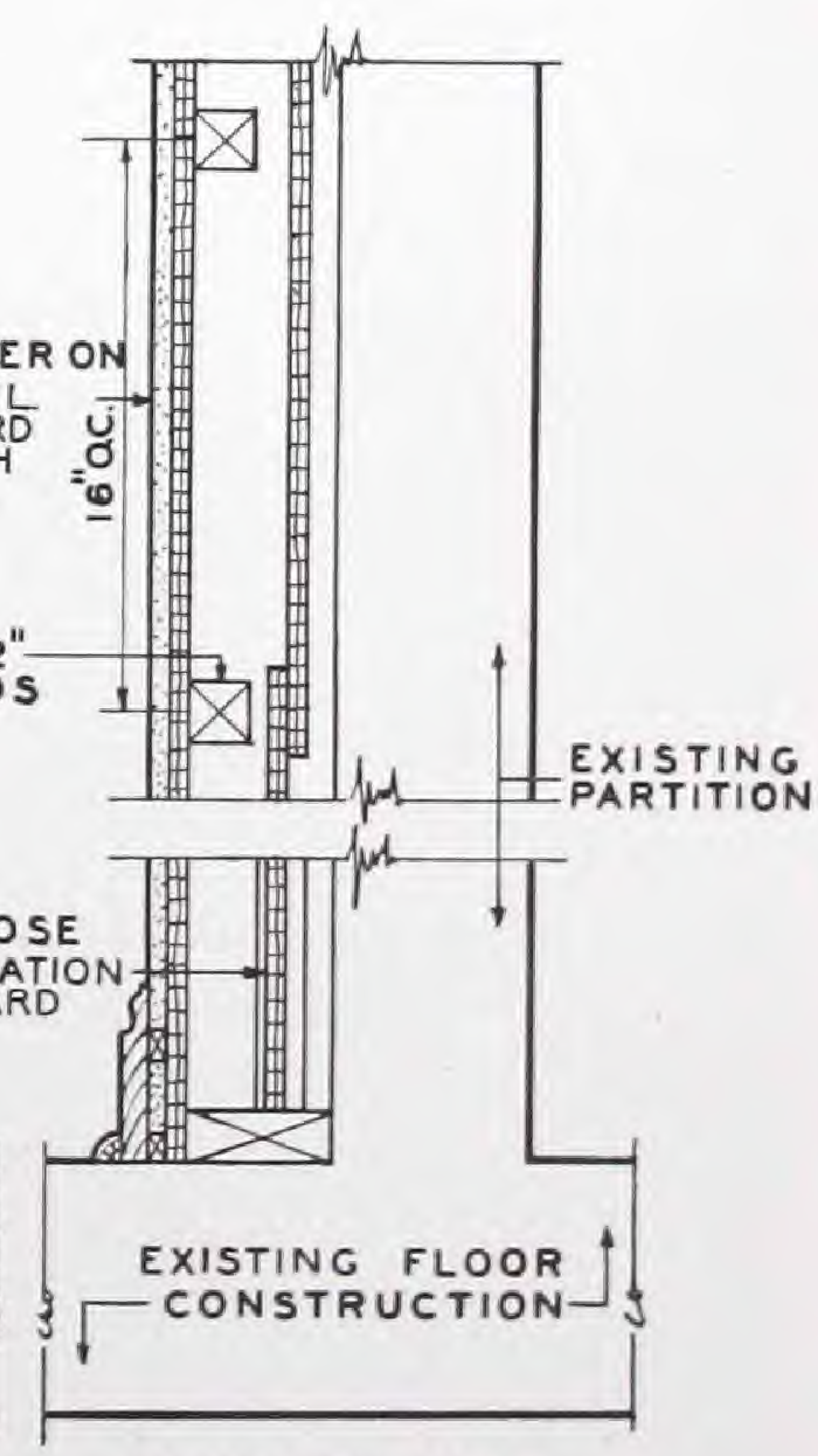
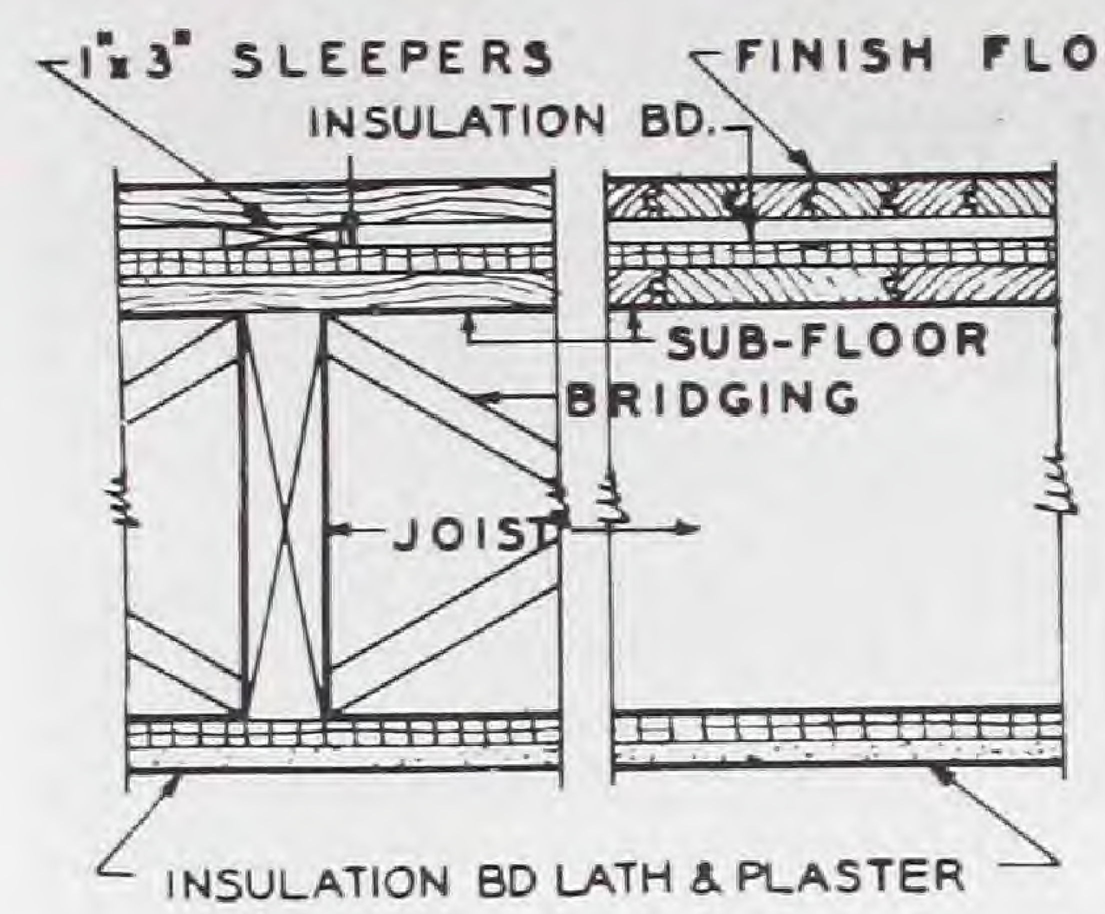


Figure 4.
Auxiliary wall construction.



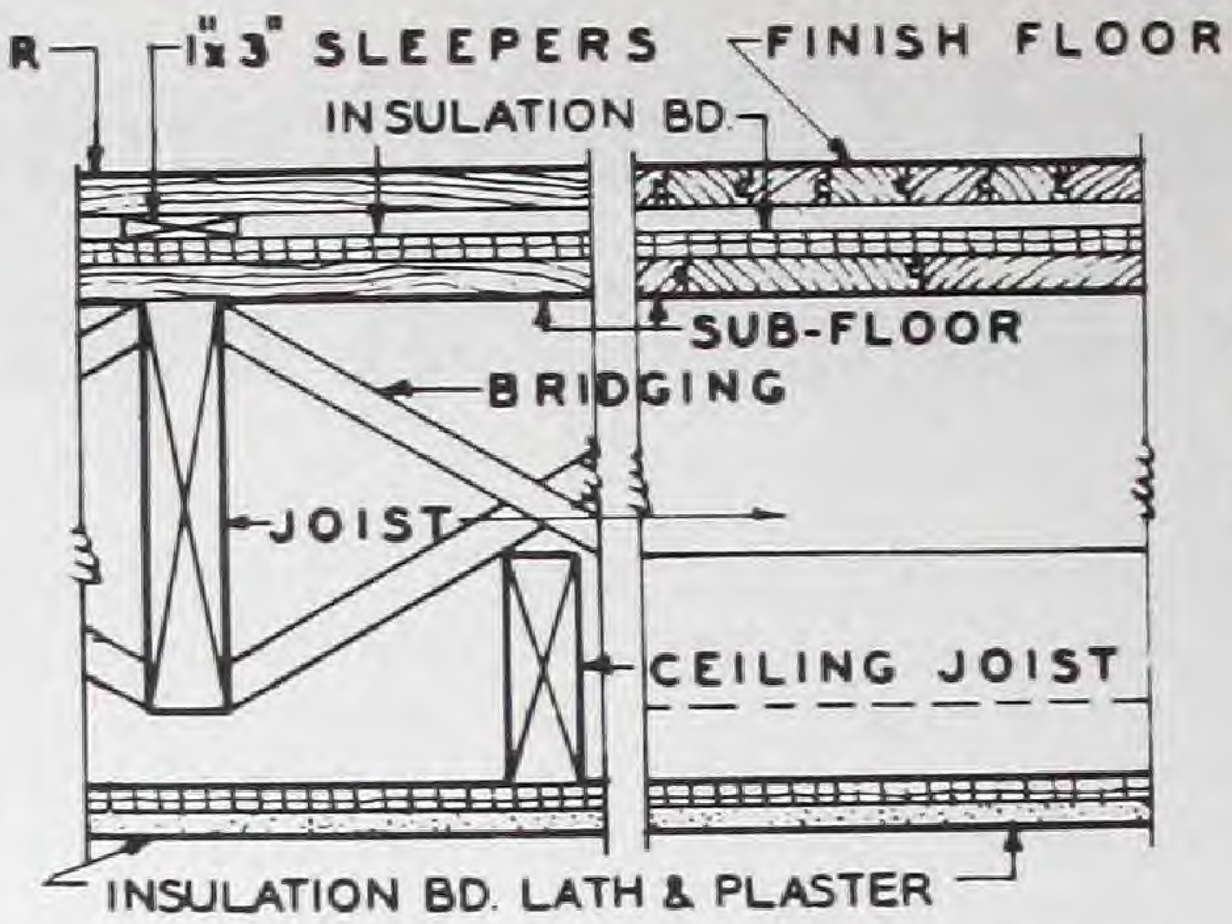


Figure 5 (Left). Floating floor construction.

Figure 6 (Right). Suspended ceiling construction.

suitable wearing surface such as battleship linoleum, parquet flooring, masonry of various types, or D. and M. hardwood flooring.

The simplest method of sound insulating wood floors consists of applying a continuous layer of insulation board upon the rough flooring, followed by 1 x 3 sleepers or furring strips on 16 inch centers to receive the finish flooring as shown in Figure 5. Sleepers or furring strips shall be securely nailed through to the sub-floor or to the joists.

For superior sound insulation, the suspended ceiling construction shown in Figure 6 is recommended. In addition to the floating floor construction referred to in the preceding paragraph, the ceiling below is supported by independent ceiling joists as shown. Floor joists should also be bridged to prevent twisting and they should fall midway between the ceiling joists. The suspended ceiling structure may be finished with insulation board lath and plaster.

Architectural Acoustics; Sound Quieting

The decorative features and application details of insulation board used for architectural acoustics and sound quieting are covered in the article on interior finish, beginning on page 4.

The acoustical requirements of building enclosures, used for speech and music vary over a wide range. For example, the convention hall seating thousands of people is used for both speech and music and has different acoustical requirements than the court room where speech

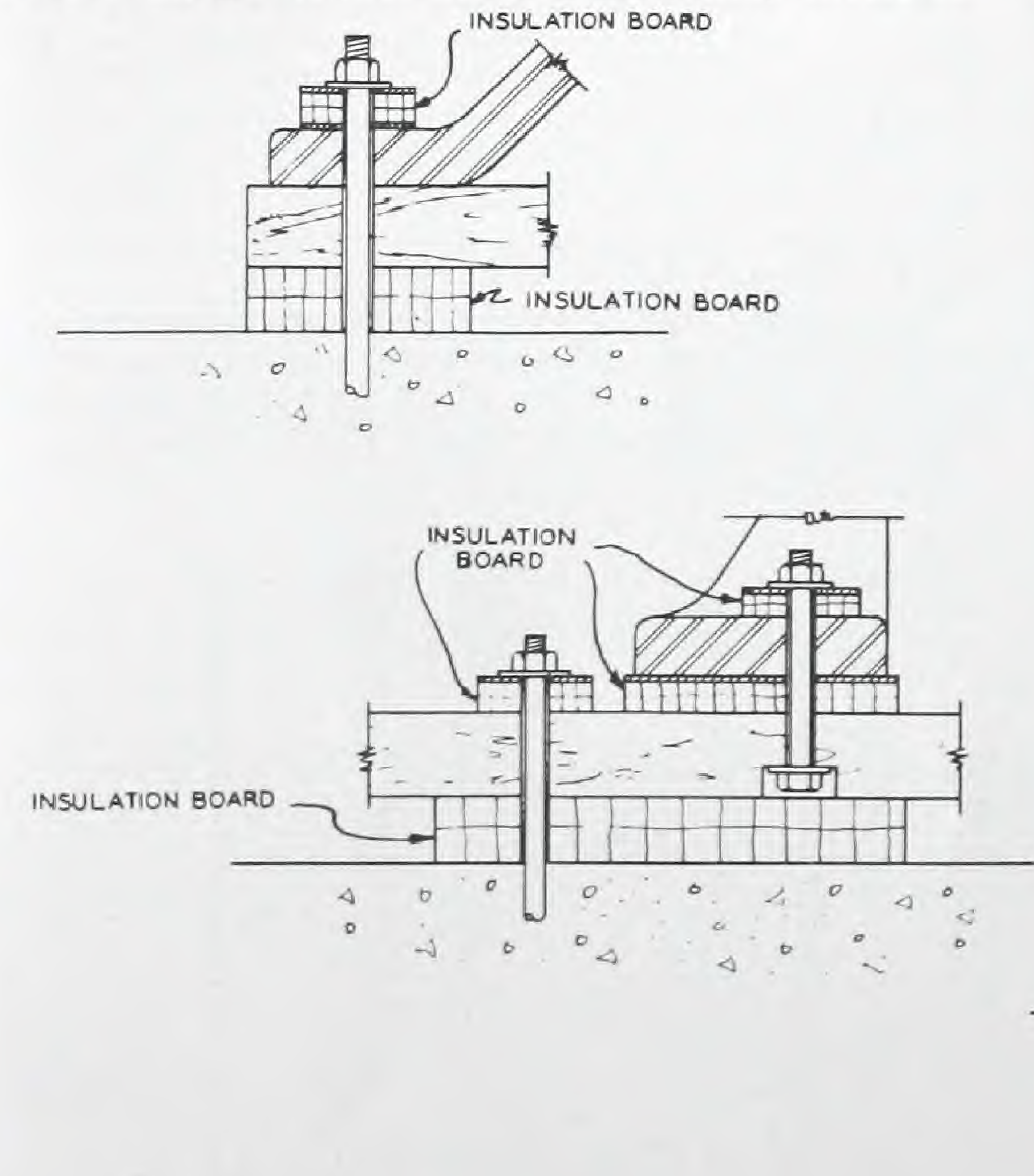


Figure 7. Methods by which insulation board can be used for isolating machinery.

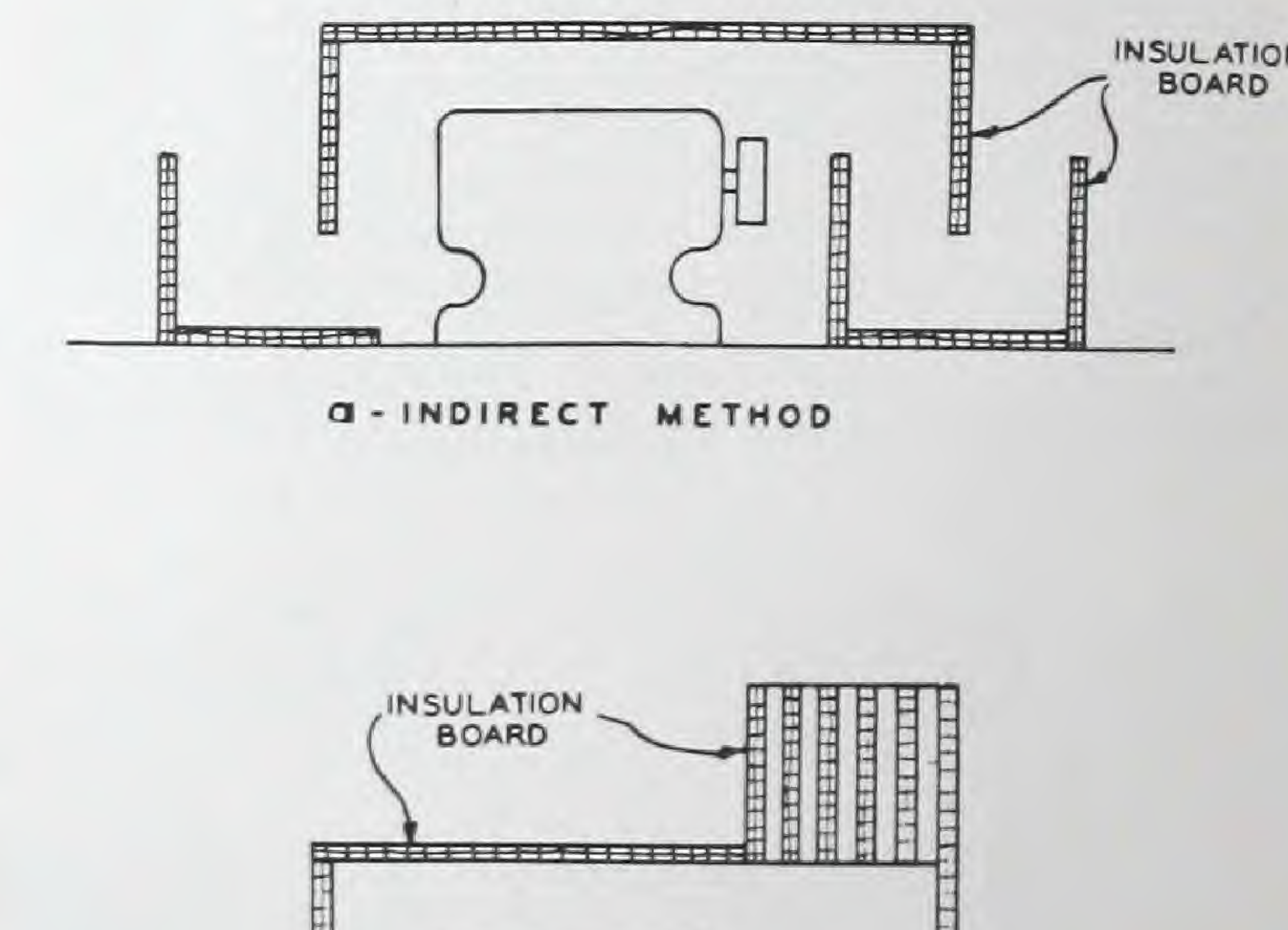


Figure 8. Methods of constructing insulation board hoods for motors and machines.

only is heard, or the music hall where speech is a minor consideration. The acoustical requirements of churches differ, and lecture room treatment is inadequate in broadcasting studios or sound movie theatres. Quieting noise in general offices is a different problem from quieting restaurants, kitchens, swimming pools, gymnasiums and hospital corridors.

Because of the foregoing factors, acoustical and sound quieting problems should be referred to manufacturers of insulation board products for recommendations. Some concerns offer special acoustical materials having high sound absorbing qualities, for this purpose.

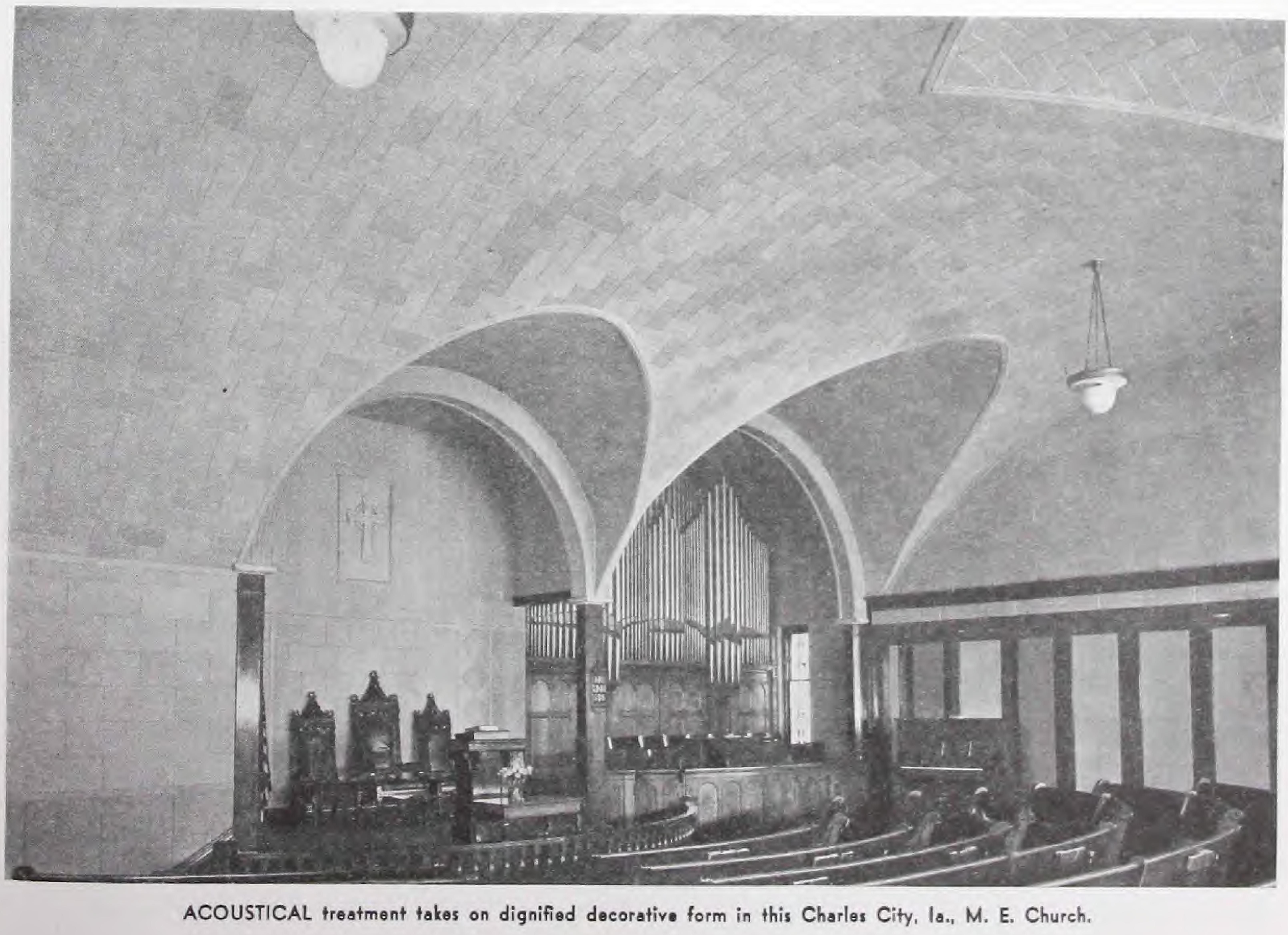
Machinery Insulation

The problems of relieving the vibration and noise due to machinery is divided into two parts, (1) that of cutting down the vibration transmitted by the machine to the building structure and (2) that of cutting down the airborne noise. The methods required to solve these two problems are entirely different.

Machinery vibration. In general, the transmission of vibration in existing machinery can be reduced by mounting the machines upon a correctly designed resilient base. Figure 7 shows methods by which insulation board can be used for isolating machinery.

Air borne noises can often be cut down by building a hood lined with insulation board. This type of material is especially satisfactory for this purpose because it is light, provides the necessary sound absorption on the inside of the hood, and does not tend to vibrate. Such hoods should be constructed so as entirely to cover the machine or motor in question. Two suggested constructions are shown in Figure 8.

BUSINESS offices are attractively finished in insulation board, and quieted at the same time.



ACOUSTICAL treatment takes on dignified decorative form in this Charles City, Ia., M. E. Church.

Insulation Board for Summer Cottages, Cabins and Camps

SIMPLE structures such as summer cottages, tourist cabins and camps differ primarily from larger and more expensive residences in the fact that the exteriors of the walls are not usually finished with other facing, nor are the interiors generally plastered. Such houses are generally built at minimum cost consistent with satisfactory service for the particular use.

Insulation board has been found by many users to be ideally suited to such types of buildings because when painted the material itself permits exposure to rain without injury and the side exposed to view on the interior makes an attractive interior finish. Where the least ex-

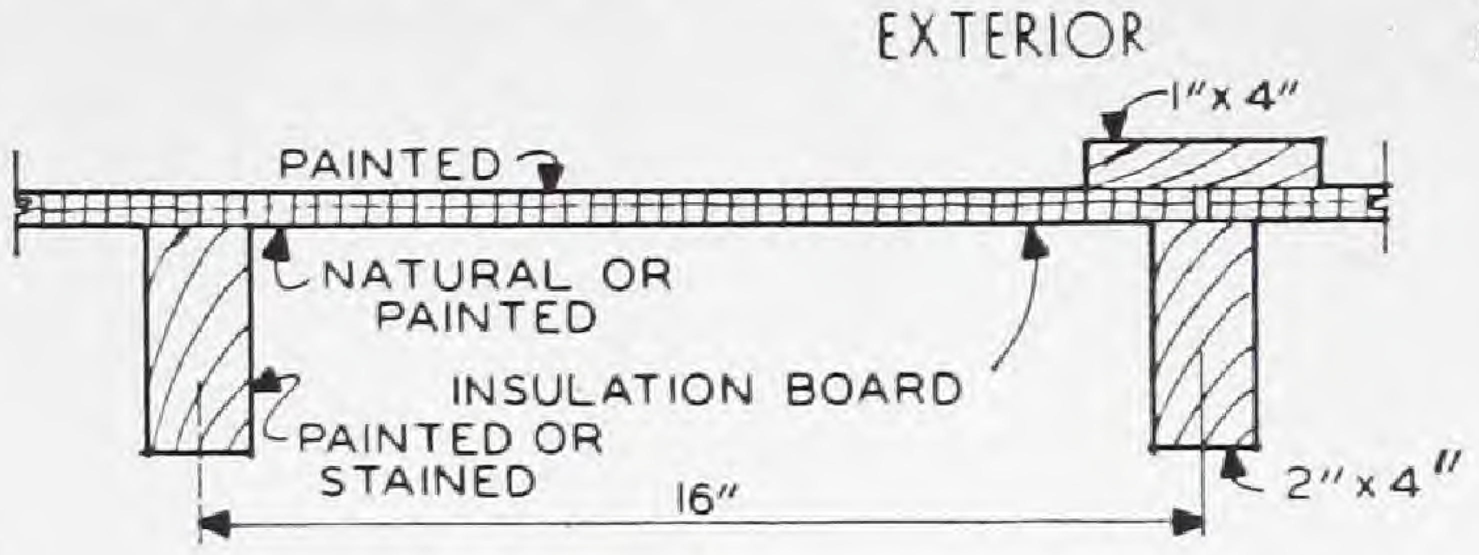


FIG. 1.

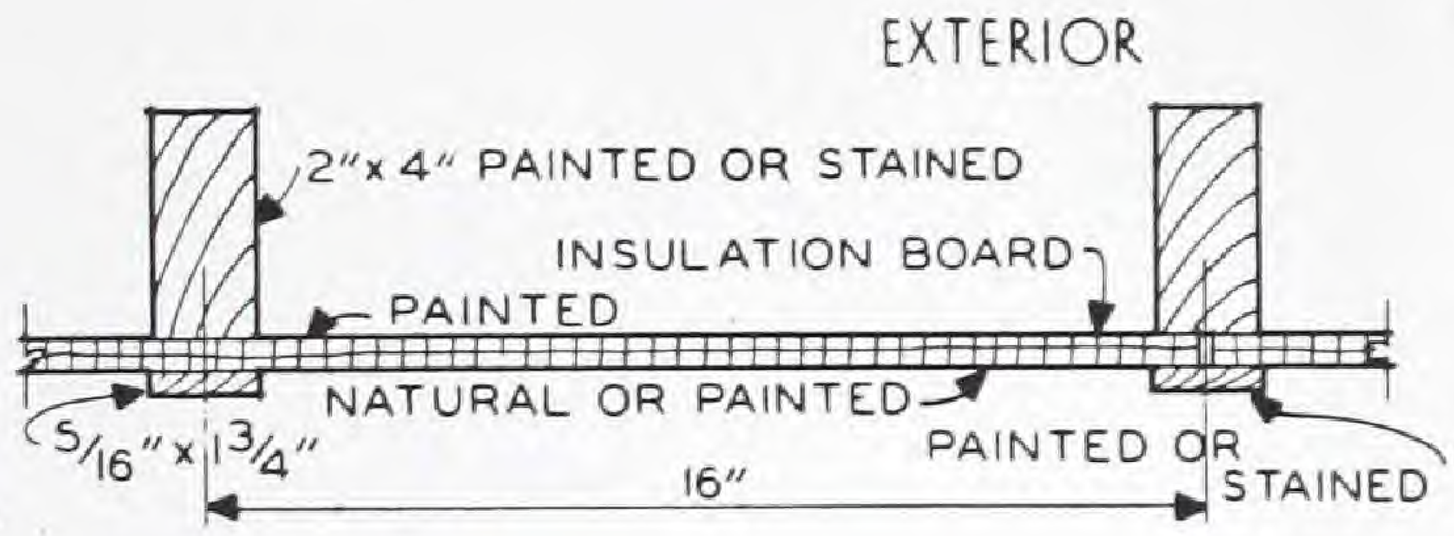


FIG. 2.

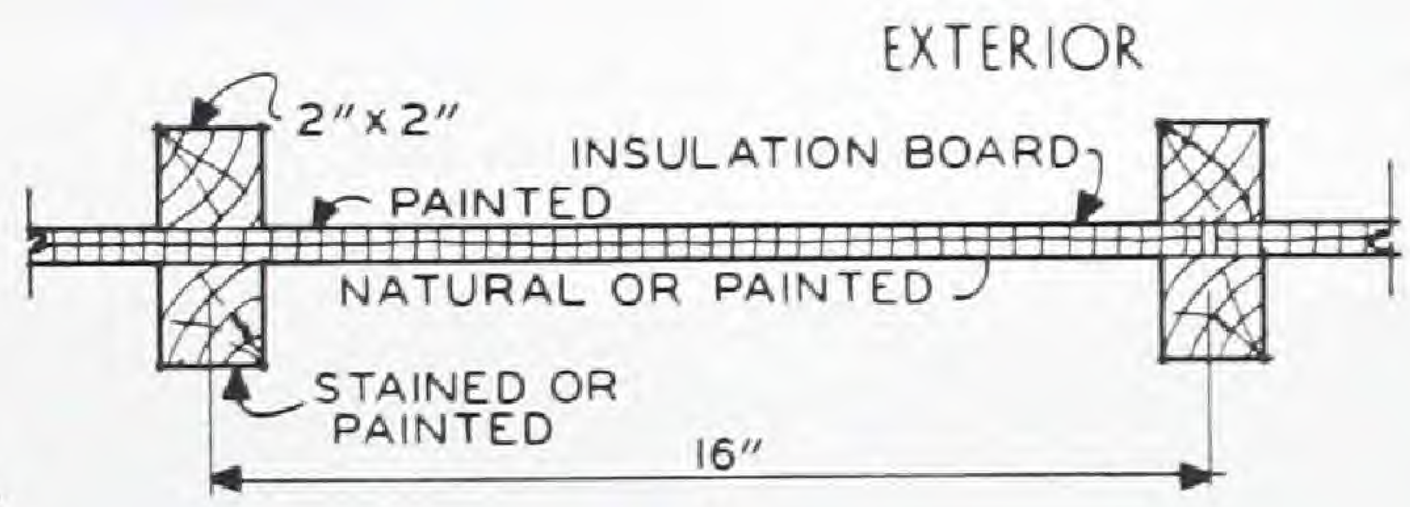


FIG. 3.

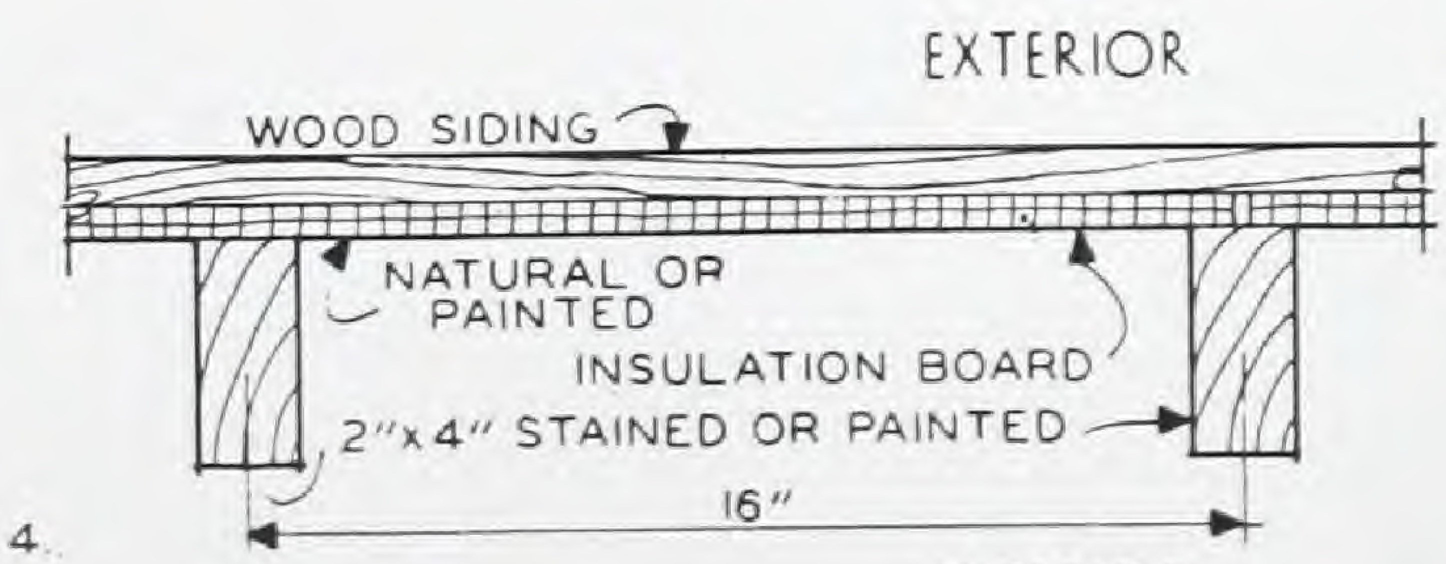


FIG. 4.

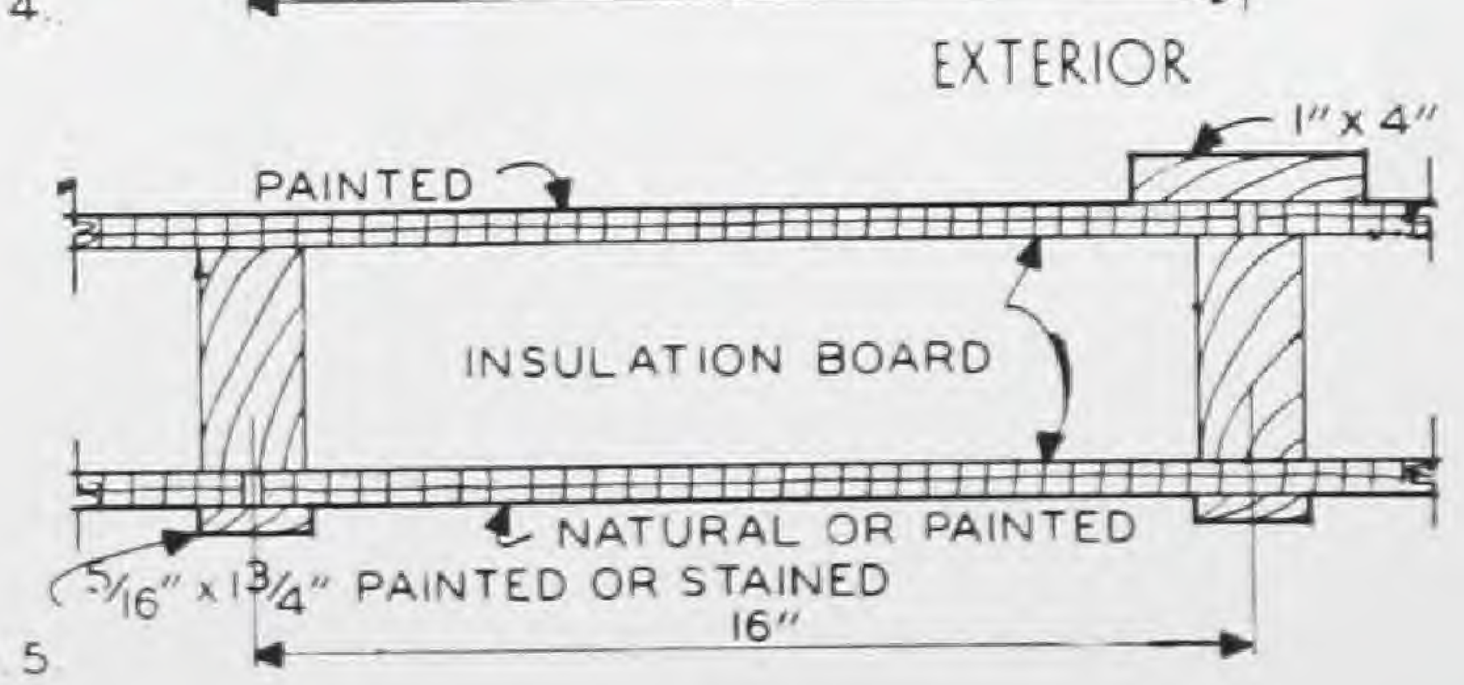


FIG. 5

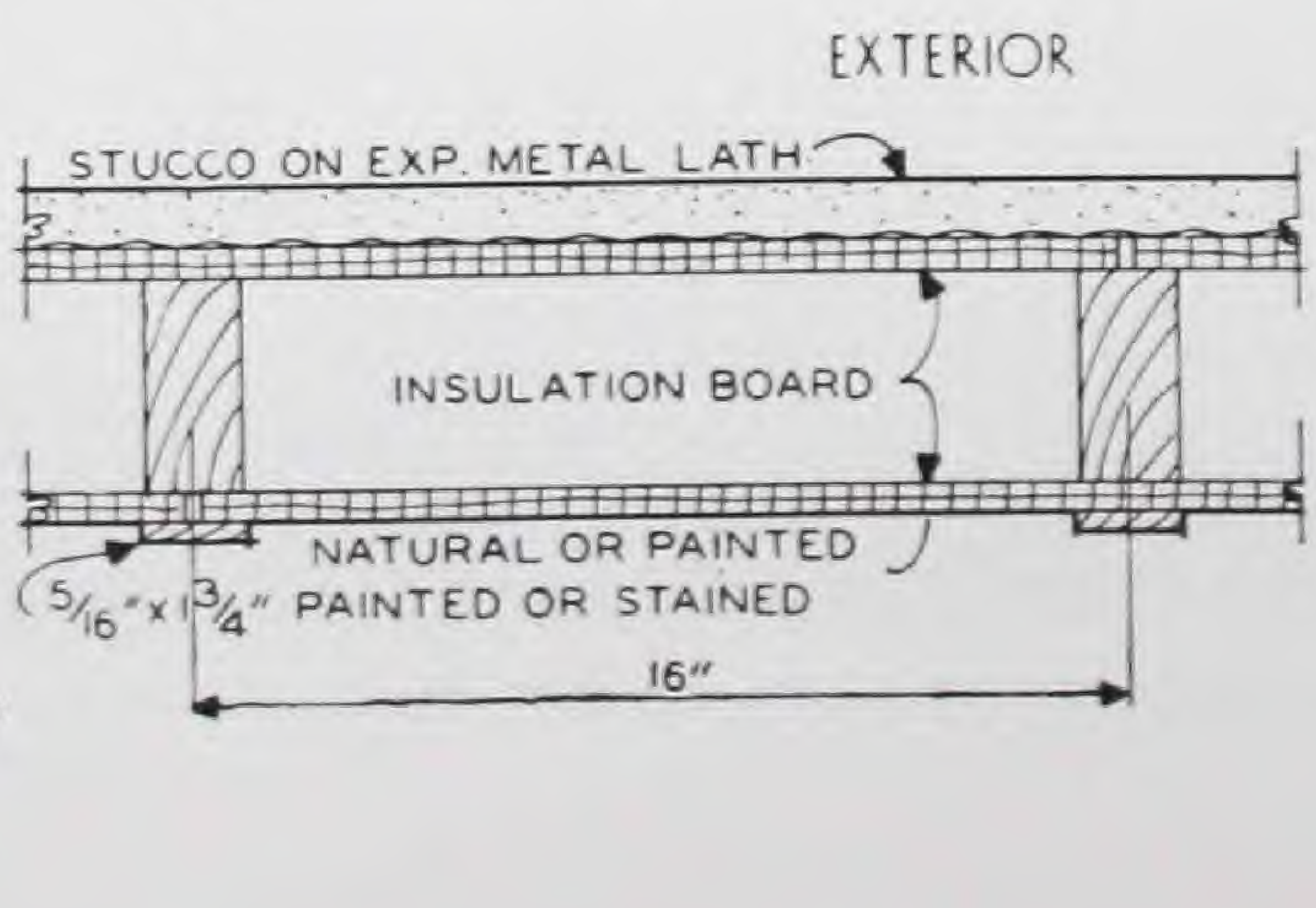


FIG. 6

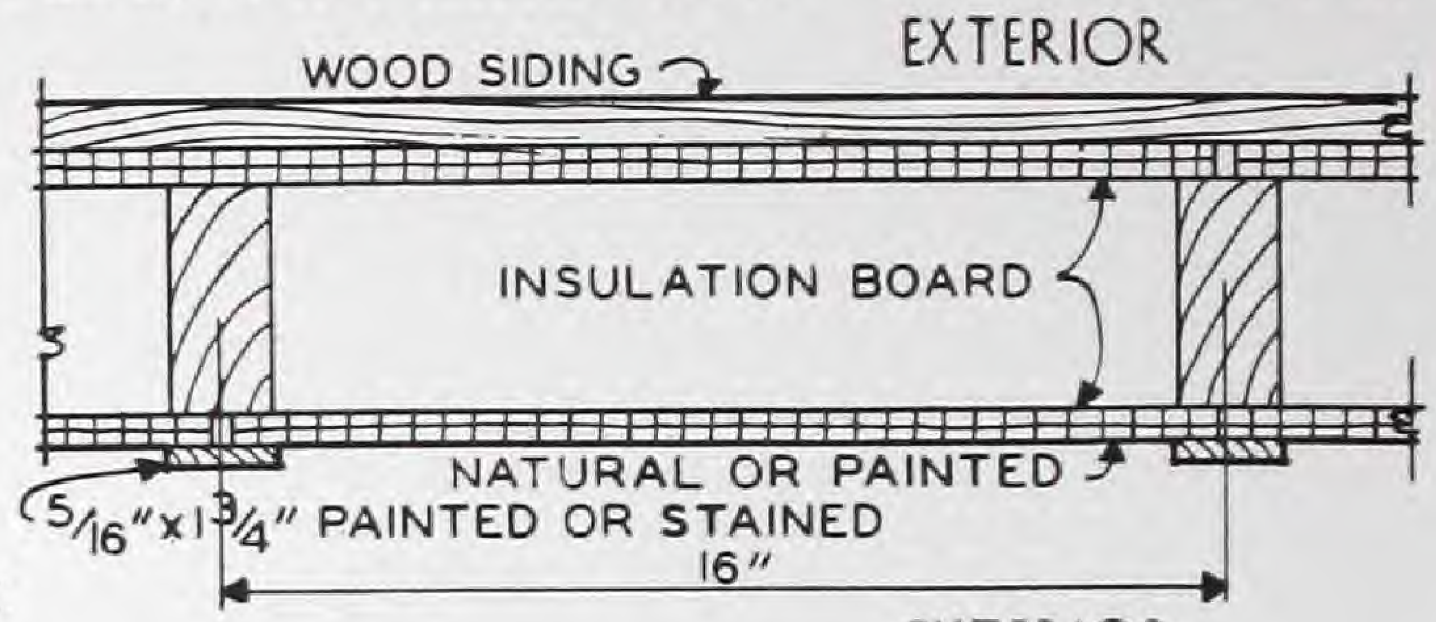


FIG. 7.

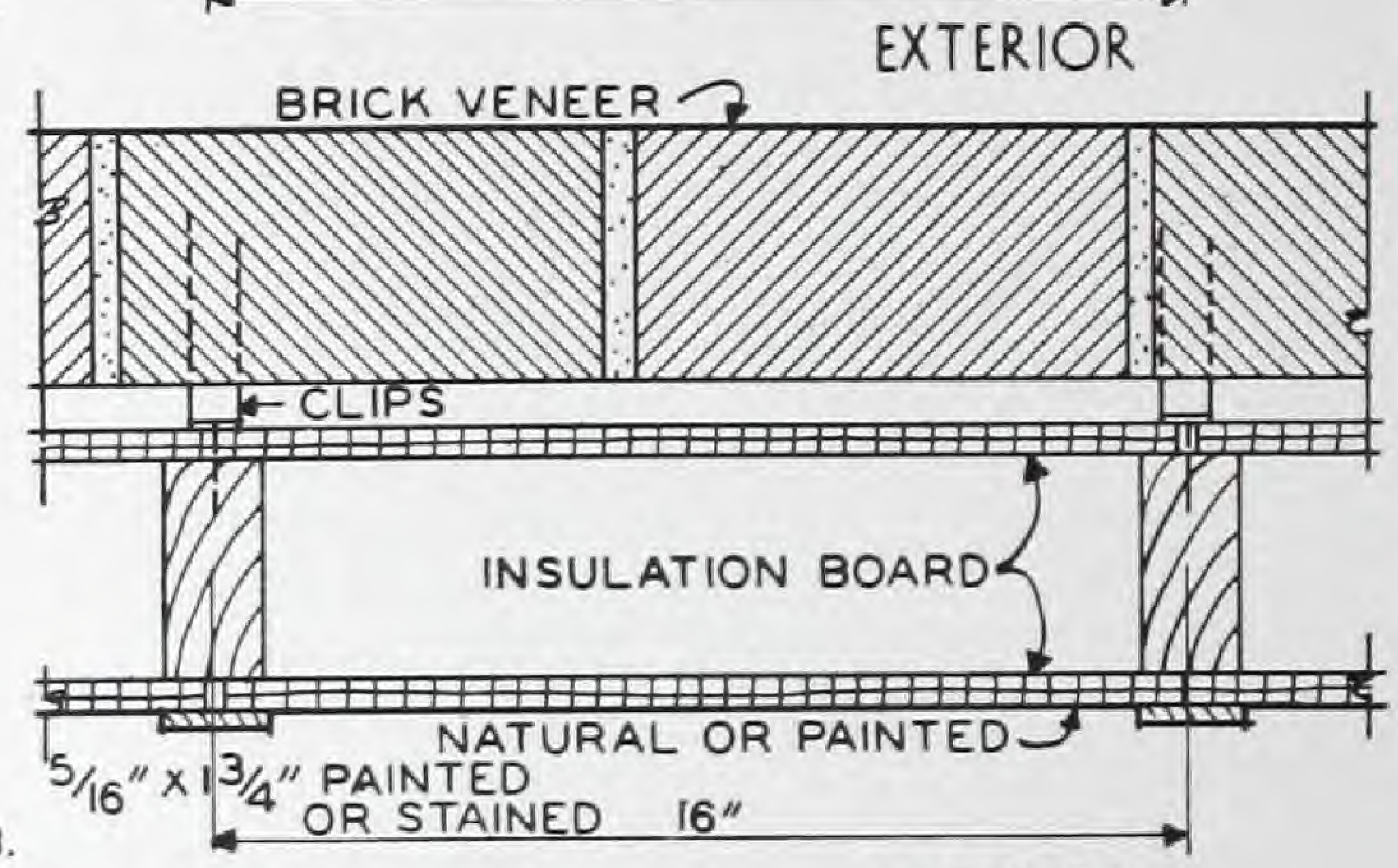


FIG. 8.

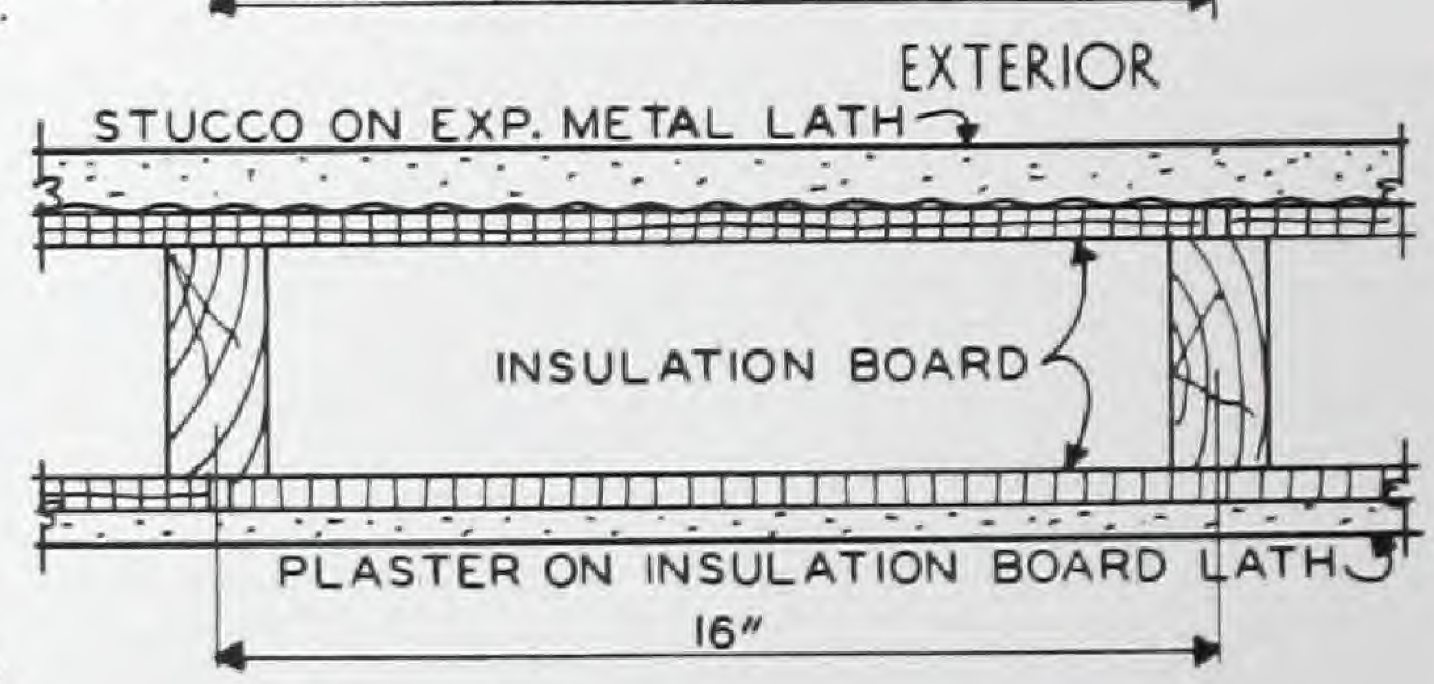


FIG. 9.

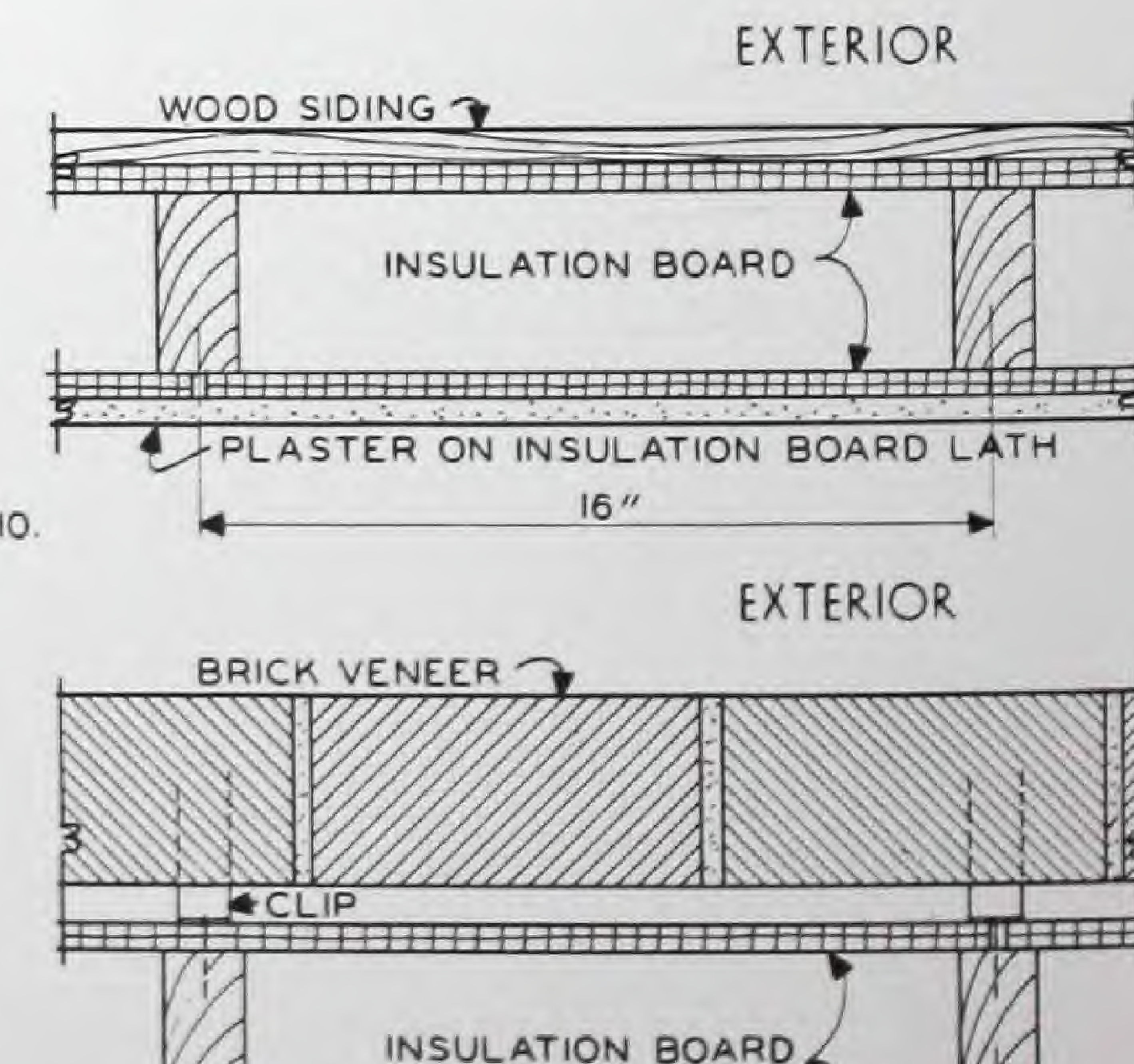


FIG. 10.

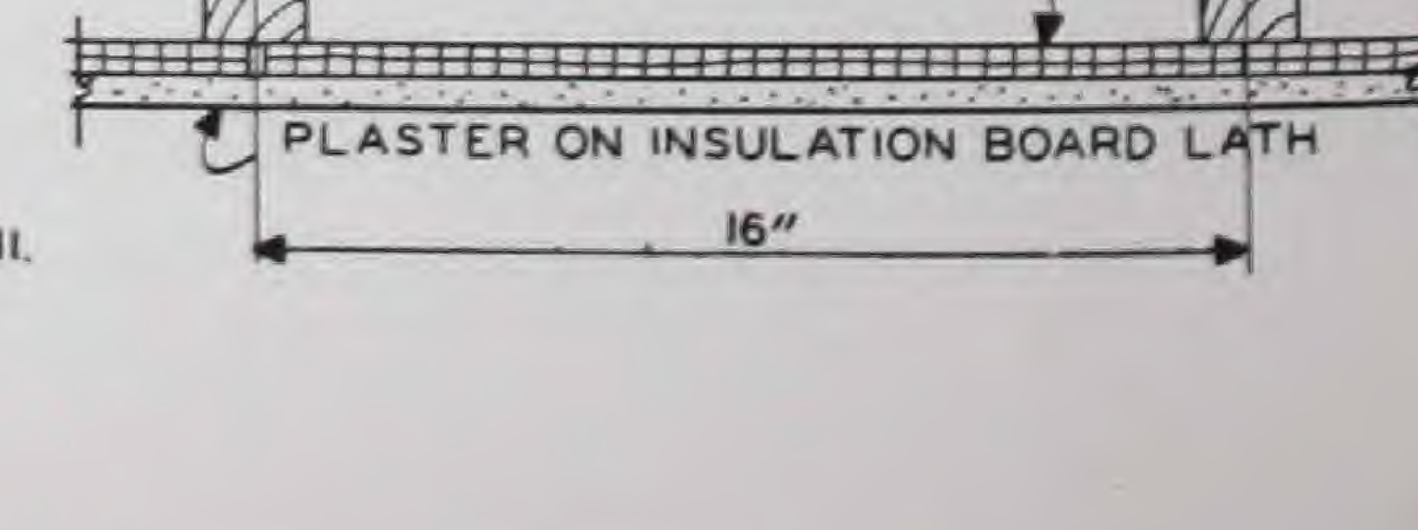


FIG. 11.

pensive structure is desired, only one thickness of insulation board is used, but in most cases two thicknesses are preferable, one on each side of the studding.

Walls

Figures 1 to 11 show some of the more common methods of using insulation board for such buildings as cottages, cabins and small bungalows. The most elementary type of wall is shown in Figure 1 and consists of ordinary 2x4 studding placed 16 inches on center with one thickness of insulation board on the outside, painted on the exterior and with 1x4 inch strips over the joints. No insulation board is used on the interior. The 2x4 studs and the interior surface of the insulation board may be painted or stained or left in their natural colors. The construction shown in Figure 1 may be modified by applying plaster to the inside surface between the studs with the plaster surface sand floated or painted, or by applying stucco to the exterior over reinforced steel fabric.

The construction shown in Figure 2 differs only from that in Figure 1 in that the 2 x 4 studding is exposed on the outside of the building. On the interior thin strips of wood are nailed vertically over the insulation board to each 2 x 4. When this is done all complications that arise in panelling the wall surface are eliminated. The narrow strips may extend from the base board to the picture molding. A modification of this wall is to omit the strips and to apply plastic paint directly to the inside surface of the insulation board. Joints are reinforced with 4 inch strips of galvanized wire door screening. The construction shown in Figure 3 has many advantages for simple houses. The 2 x 2 vertical members on each side of the insulation board made an attractive exterior as well as interior finish.

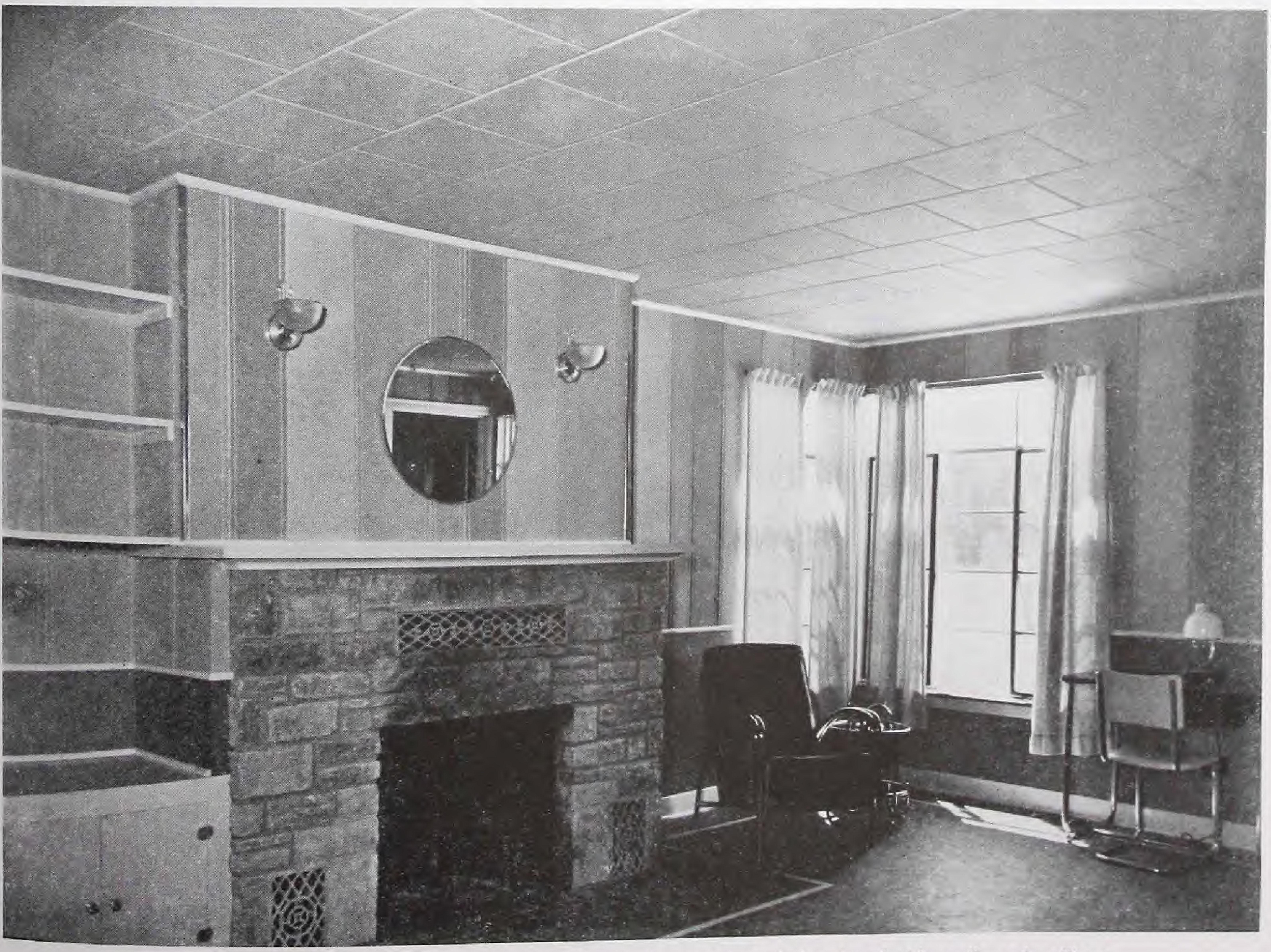
The wall shown in Figure 4 differs from that shown in Figure 1 by the addition of wood siding nailed through to the studding. The 2 x 4 studding is exposed on the interior of the building.

Figure 5 shows a frame wall using two thicknesses of insulation board. Figures 6, 7, 8, 9, 10 and 11 are standard frame wall constructions which are included for comparison but which are also suitable for the more expensive summer cottages. Application details for these walls will be found elsewhere in this issue of *American Builder,* as well as instructions for painting the surface of insulation board, and for applying special interior finish products.

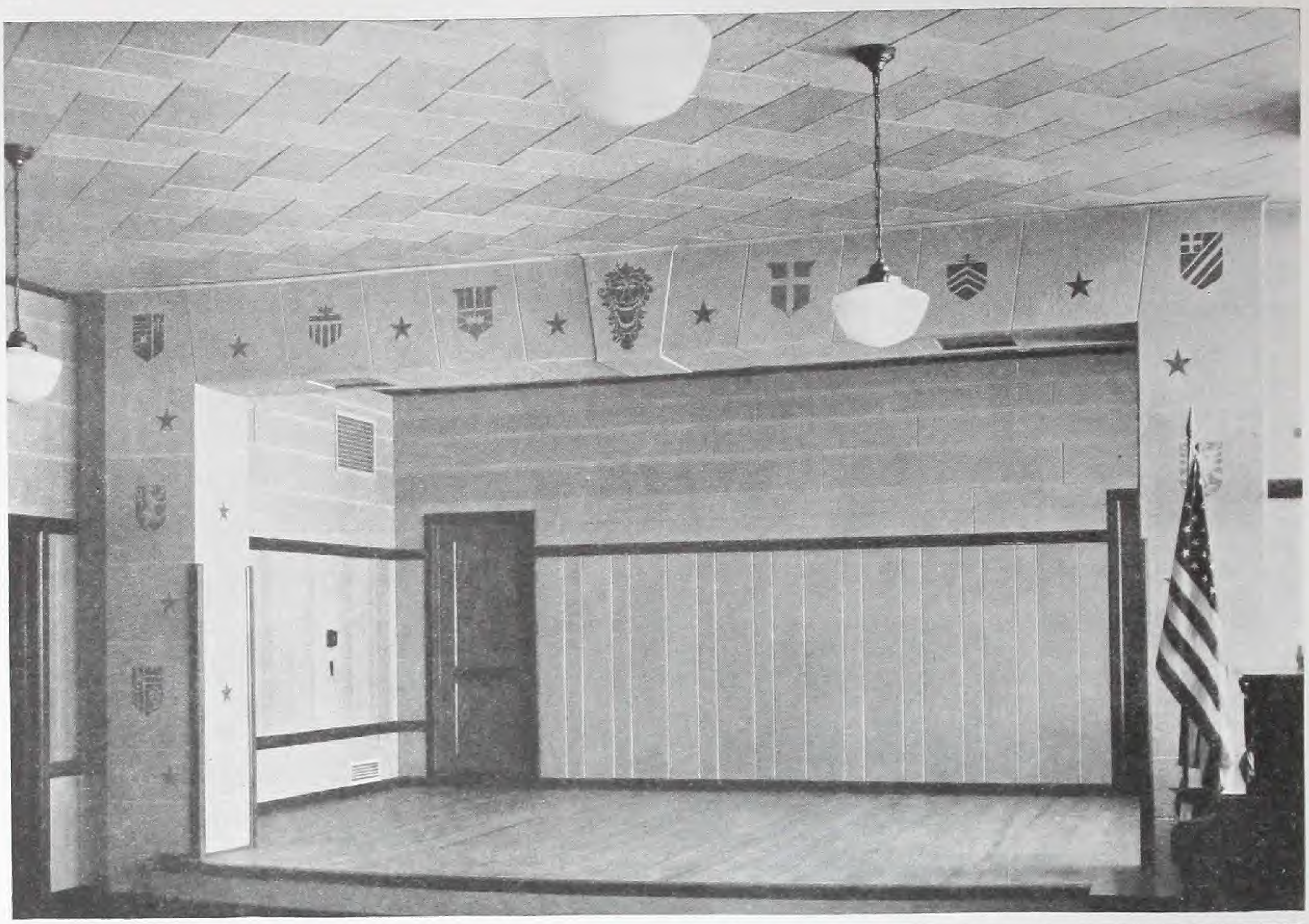
Roofs

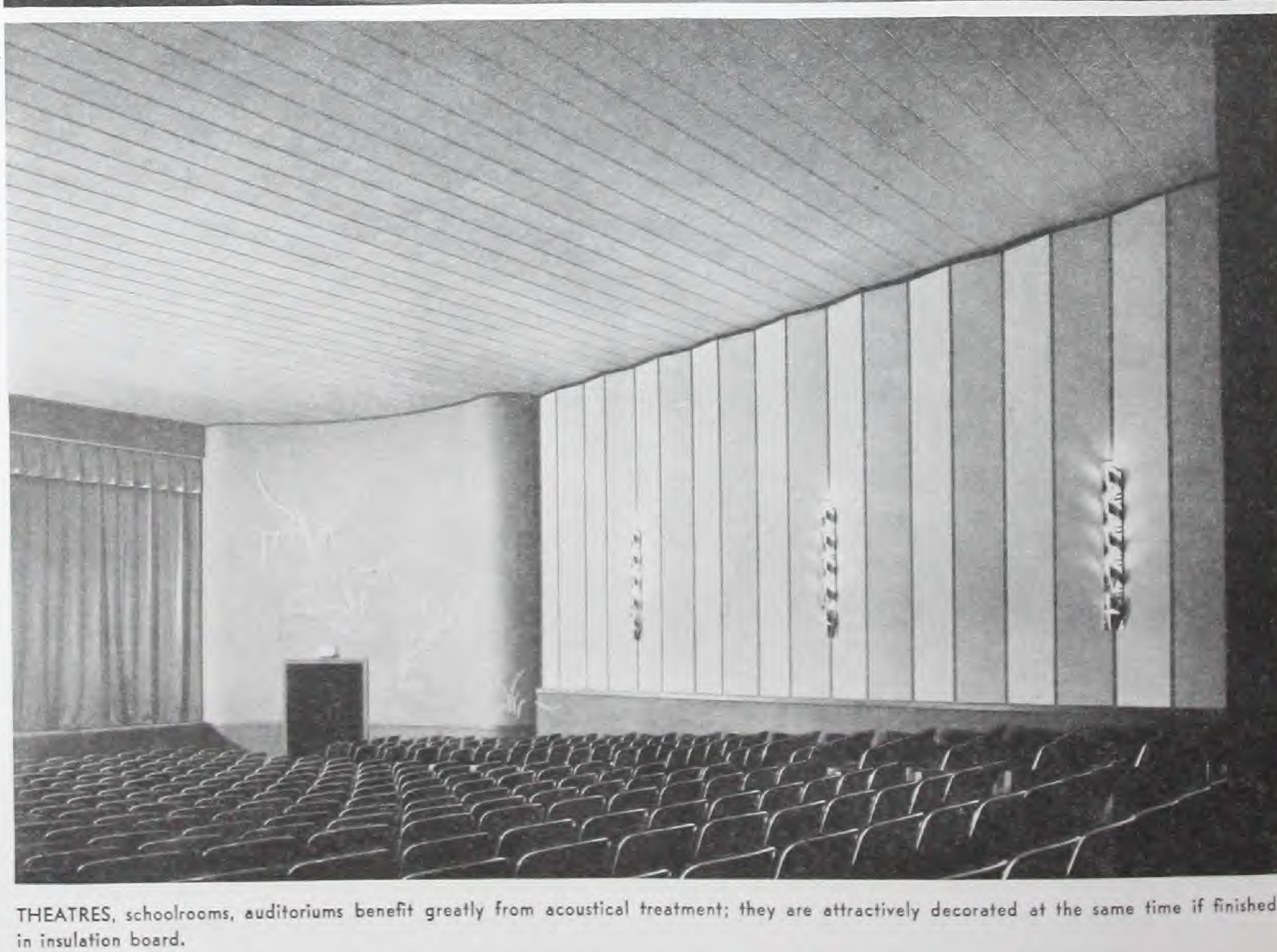
Insulation of cottage or cabin roofs is important as such buildings are usually occupied in summer when the summer heat beats down on the roof, often making the rooms uncomfortably hot. With insulation board in the roof or the ceiling this condition is immediately changed.

There are three places in which insulation board is used to advantage in the tops of simple dwellings: (1) on top of the roof rafters; (2) under the roof rafters and (3) on ceiling joists as a ceiling. For better insulating effect insulation board should be used in at least two of these places. It should not be used on top of roof rafters without wood sheathing in case of flexible roof covering or without wood nailing strips in case of rigid roof covering such as wood shingles.



NEWEST effects in summer homes are achieved with decorative insulation board side walls and ceilings.





THEATRES, schoolrooms, auditoriums benefit greatly from acoustical treatment; they are attractively decorated at the same time if finished in insulation board.

Insulation Board on the Farm

WELL-BUILT farm buildings for live stock use insulation board liberally; this Jersey cattle barn at Morristown, N.J., contains 8000 feet; John T. Rowland, architect.

INSULATION board is needed in practically every farm structure as it has a favorable influence on the control of temperature. This in turn is a factor in maintaining comfortable dwellings, comfortable shelters for animals, in saving feed and fuel, in effecting a decrease in mortality of young stock, in increasing yields from mature stock, in preventing frozen water pipes and in the preservation of food.

Dwellings and Animal Shelters

The value of insulation board in the walls and roof of the farm home cannot be overemphasized. In this respect, the farm dwelling is no different from any other type of residence. Where insulation board is used, less fuel is required for winter heating and in the summer the rooms are cooler.

In extremely cold climates, the comfort of animals becomes an important factor. Cold air and cold walls are two sources of discomfort. Cold air carries away body heat by conduction and convection whereas cold walls increase the amount of heat radiated from their bodies. Insulated walls which increase both air and wall temperatures, therefore, have a two-fold beneficial effect on animal comfort. Furthermore, the farm chores are more pleasant when temperature extremes within the barn are avoided.

Saving of Feed and Fuel

The heat required to warm animal shelters must come either from the animals through food consumed, or by the combustion of fuel. Food energy utilized for heating is not available for production purposes. Satisfactory temperature conditions cannot be maintained in cold weather without excess feeding or unnecessary loss in production in improperly insulated and ventilated structures. The use of insulation board not only permits the maintenance of proper temperatures but will also reduce fuel consumption where artificial heat is employed.

Mortality and Production

The health of young animals and chickens is easily affected by cold air and drafts. Although the proper use of insulation board may not be the sole factor in improving these conditions, it will have an important influence on the retention of the available heat within the structure, thereby correcting one of the major defects of animal housing.

In addition to the decrease in the mortality rate of young stock, warm structures have a favorable influence on the yield of mature animals. It is a well-established fact that sudden drops in inside temperature often cause a decrease in milk flow and egg production, whereas uniform, comfortable temperatures are conducive to maximum production.

Storage Houses

Fruits and vegetables can be kept in good condition for months by maintaining the air of storage houses in the proper temperature and moisture conditions. In storages that are not heated, preservation would be impossible in many cases if it were not for insulating materials that efficiently retain the small amount of heat available in cold weather or keep out intense summer heat.

Insulation Influences Ventilation

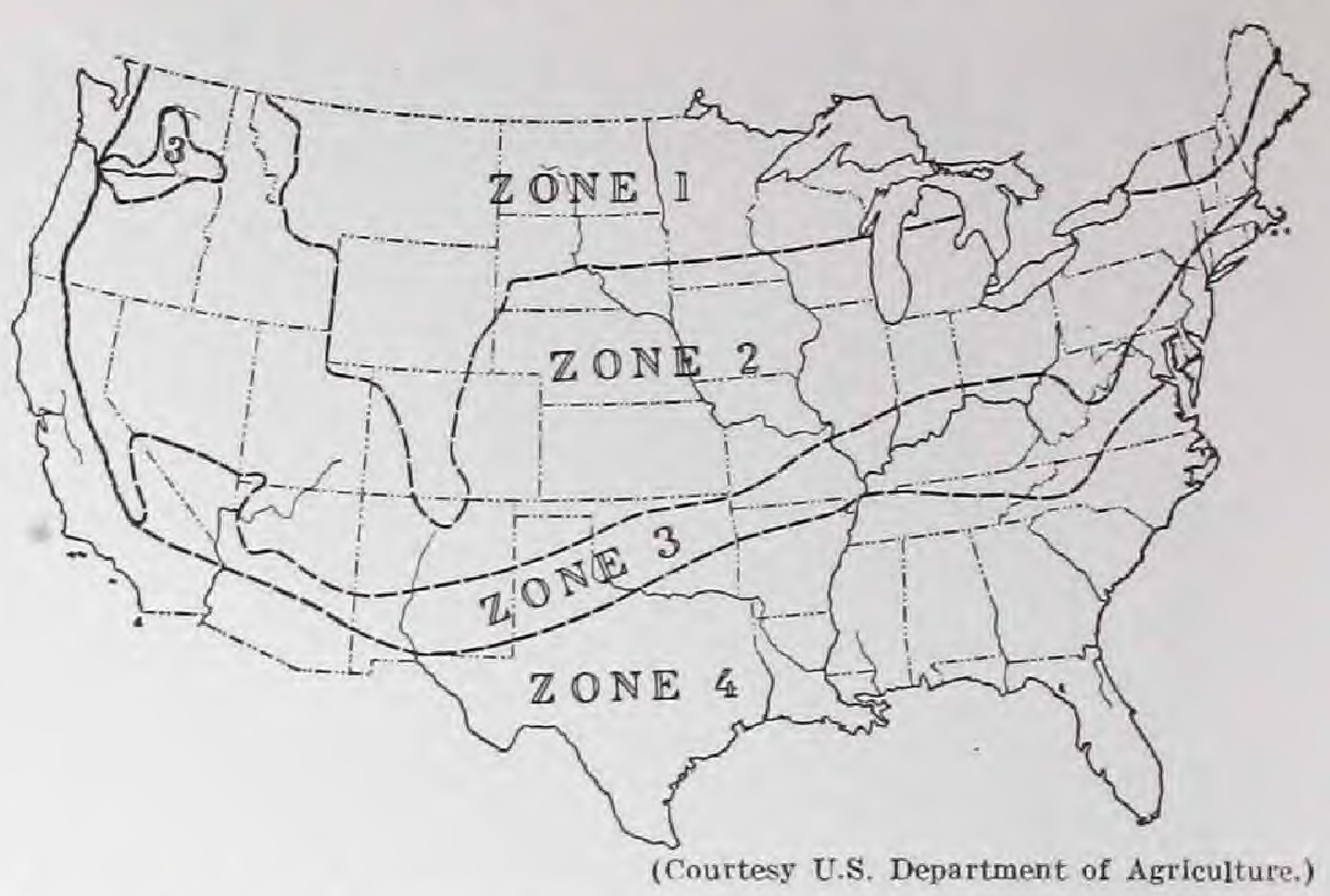
Stables, poultry houses, storage buildings for fruits and vegetables and similar structures must be properly ventilated. In order to maintain comfortable temperatures for animals and to avoid freezing of the stored crops, the structures must be built tightly. Consequently, proper ventilation must be provided in order to avoid foul inside air and to prevent frost or condensation from collecting on the walls and ceilings of such structures.

To have a dry, well-ventilated building, two conditions are necessary—first an adequate supply and well-distributed movement of air which will carry off excess moisture given off by stored crops, and second, warm walls and ceilings. It may be possible to provide an ample quantity of air in buildings with cold walls, but it is not possible to avoid wet surfaces or to maintain proper temperatures in cold weather if a great amount of heat is wasted because of lack of insulation.

Dampness on inside building surfaces may be caused by one or more of several factors such as improper or inadequate ventilation, leaky construction, insufficient heat or lack of insulation. Dampness due to condensation may be prevented by diluting the inside moist air with outside

dry air through added ventilation or by the application of insulation board to the surfaces involved or by a combination of these two methods.

It is apparent from the foregoing discussion that insulation board plays an important part on the farm and should be used in practically all farm buildings. Details of application of insulation board in the construction of dwellings will be found elsewhere in this issue of the *American Builder* and include the use of this product for interior finish, wall and roof sheathing and plaster base. The following information relates to the use of insulation board for constructing and insulating various types of animal and poultry shelters.



(Courtesy U.S. Department of Agriculture.)

Figure 1. Map showing zoning of the United States with respect to temperature.

Dairy Barns

As a production machine the cow is sensitive to conditions of environment and responds favorably to proper care and attention. The heat produced by cows is not sufficient to warm uninsulated barns in cold weather. Consequently, insulation and ventilation are two features of construction that must be given serious consideration.

Experience has shown that a ventilating system properly installed in a barn with insulated walls will operate more successfully than one installed in a structure that allows heat to escape readily. On the other hand, in a barn tightly constructed and well insulated it is essential that an adequate ventilating system be provided in order to insure a sufficient supply of fresh air at all times.

The questions which naturally arise are (1) which parts of the barn should be insulated, (2) how much insulation board is required and (3) how should it be applied?

Where to Insulate: The ceiling and walls of the stable and the outlet flues of the ventilating system are the parts of the structure that require insulation board.

Ceilings are important, since the temperature there is always higher than elsewhere, because of the fact that heat rises. Not only is the need for insulation at the ceiling greater than elsewhere, but insulation board placed at this location will be more effective than when used in the walls or floors. In barns with hay stored above the stable the ceilings usually are well insulated in the fall and early winter by the hay in the mow, but as the stabling season progresses and food is consumed the insulating effect is lost if the mow floor is bare. For this reason, it is well to leave 6 to 8 inches of hay or chaff on the floor at all times. A smooth, tight ceiling promotes sanitation, reduces the volume of air that must be heated, and improves air circulation and ventilation, which might otherwise be obstructed by the projecting joists.

From the standpoint of heat loss, walls also are important, for through them much of the heat normally escapes. Moreover, in the colder parts of the country, not only should the frame and masonry parts of the structure be insulated, but glass areas should be protected with storm windows. Insulation board and storm windows will go far toward eliminating the chilling effect on the stock that results from cold wall and glass surfaces.

Insulating the outlet flues is usually necessary to the proper functioning of the ventilating system. If the outgoing air is chilled inside the duct, the capacity of the system is reduced, and condensation, with consequent dripping from the lower end of the flue, is likely to result. Insulation board, scored on one surface to permit bending and conforming to the flue, may be used for this purpose.

How Much Insulation? From an economic point of view, the proper thickness of insulation board would depend upon the savings in food consumed and the increased production resulting from the warm shelter as compared with the cost of insulating. The most accurate method of arriving at the insulation thickness is to balance the heat losses through walls, windows, doors, ceiling or roof against the heat known to be available from the stock. Obviously, the losses will vary directly with the outside temperature, so more insulation will be required in cold climates than in warm climates. In maternity and calf barns, proportionately less heat is available from the animals; hence more insulation is needed for given temperature requirements.

Practically, it is not necessary to resort to this degree of refinement to determine the amount of insulation required. The temperature zone map of the U. S. Department of Agriculture (Figure 1) will serve as a guide for selecting the thickness of insulation board for practical dairy barn temperature control.

In Zone 1 the average normal temperature during January and February is 5 degrees above zero, the average extreme, —10 degrees, and the lowest desired stable temperature, 38 degrees. In Zone 2, the average normal temperature is 16 degrees, the average extreme is zero and the lowest desired stable temperature is 42 degrees. In Zone 3, the average normal temperature is 27 degrees, the average extreme is 10 degrees and the lowest desired stable temperature is 48 degrees.

Insulation board, 25/32 or 1 inch thick is required on the ceilings and side walls of dairy stables to allow proper temperature control and practical ventilation in Zone 1 and northern Zone 2. In the southern part of Zone 2 and entire Zone 3, ½ inch insulation board is required on ceilings and walls of dairy stables for satisfactory temperature control and ventilation. All walls of siding require ½ inch insulation board nailed on studs or nailing strips 16 inches on center. Walls sided and sheathed, or lined with matched boards, frequently do not need insulation if *tight*, or if they do not get wet due to "sweating" in cold weather. Otherwise they should be lined with ½ inch insulation board. Greater thicknesses of insulation board will give better temperature control at slight additional cost.

Application of Insulation Board

Insulation continuity should be maintained. Apply insulation board with the length parallel with framing members. Boards shall be of proper length completely to span between sills and plates or other structural members. All joints shall center over framing. In some framed walls, additional studs and headers are usually needed.

Space boards ⅛ inch apart at all edges. At window and door frames bring insulation board in close contact with framing members. Insulation boards are usually ⅛ inch less than full theoretical dimensions to allow for this spacing on standard framing. Batten joints between boards with metal barn battens. On some masonry walls 1 x 2

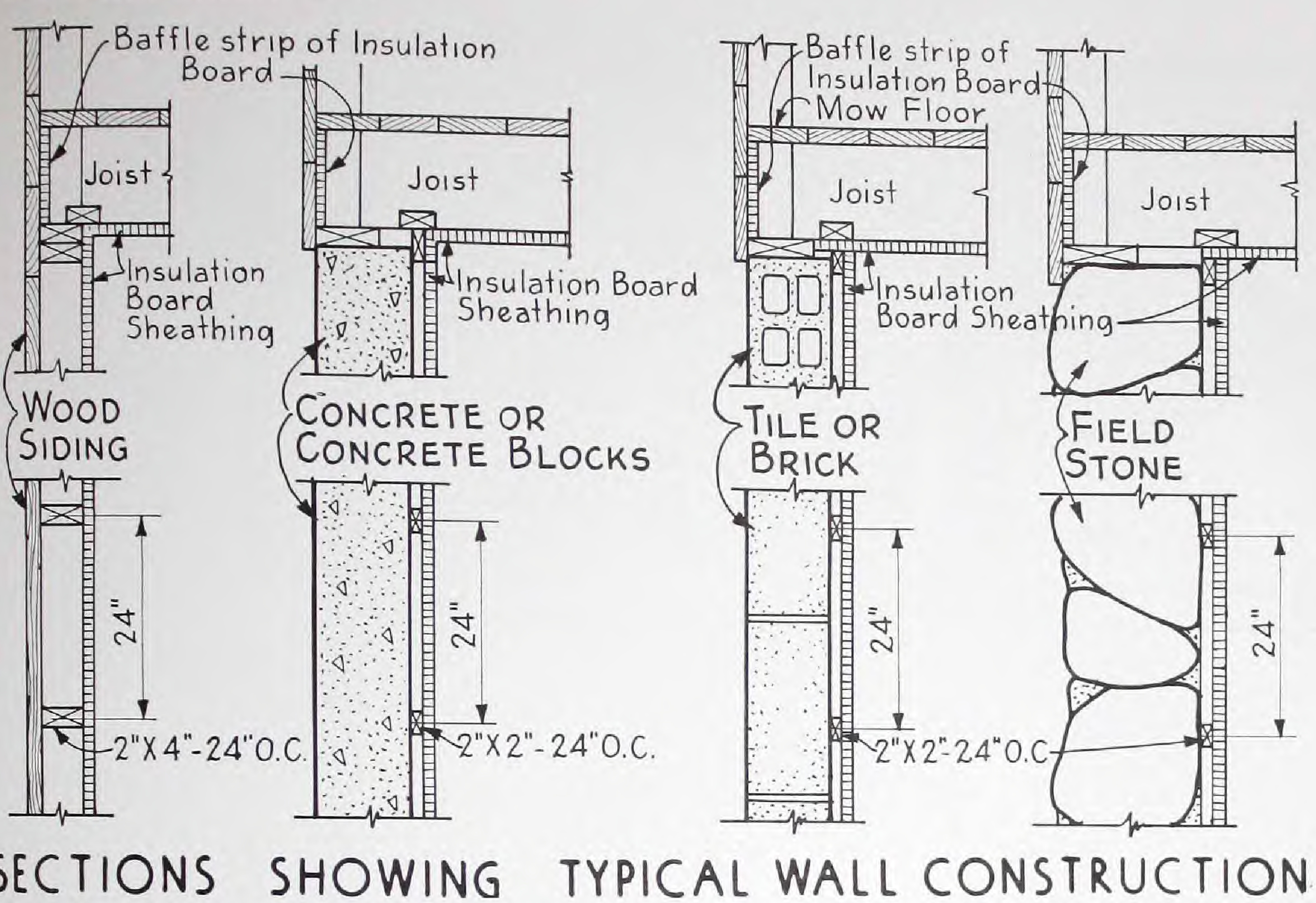


Figure 2. Various types of dairy-barn wall construction, showing application of insulation board.

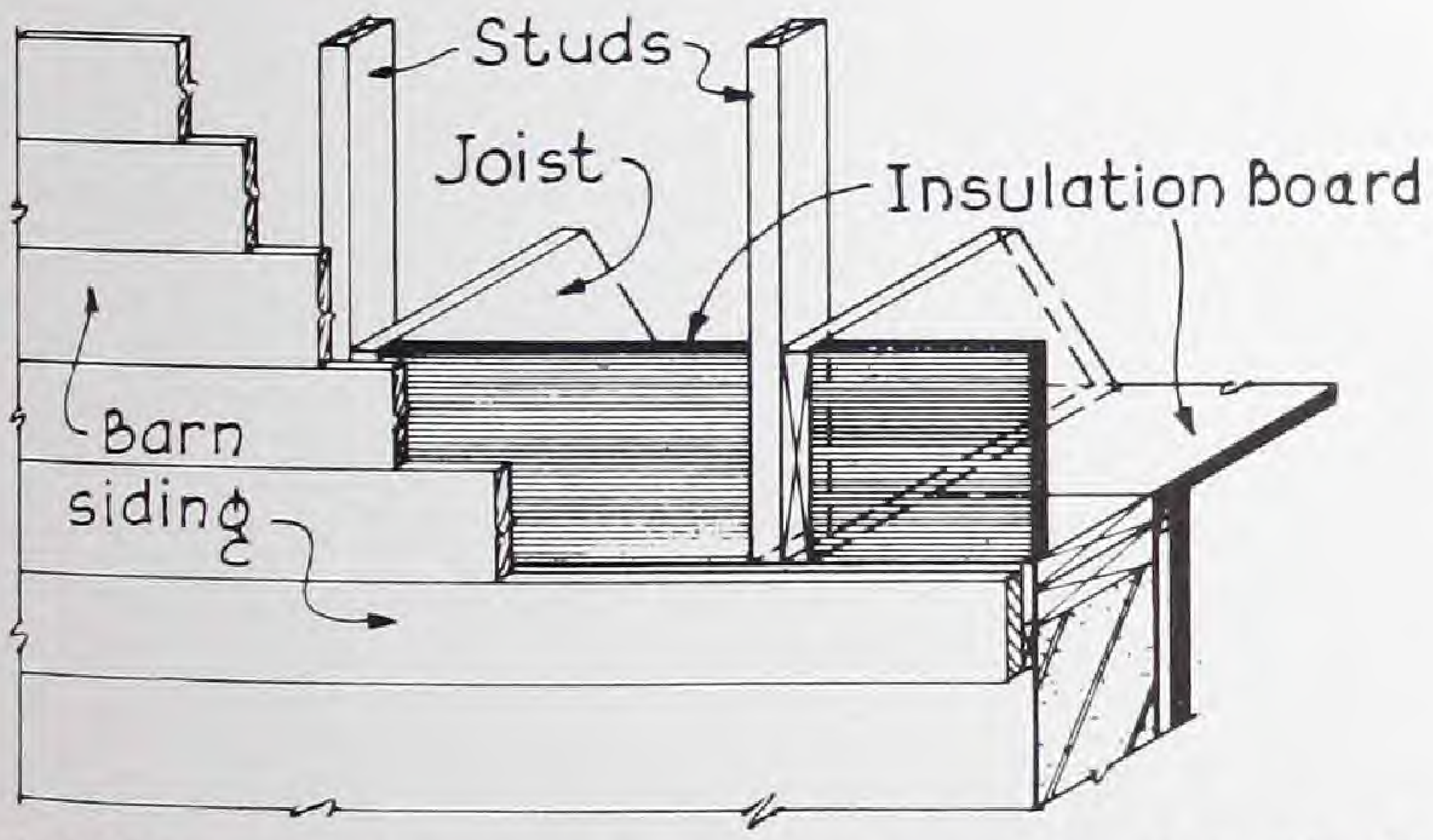


FIGURE 2-A. How to insert insulation board between studs in old wall.

inch nailing strips are required as a nailing base for insulation board wall lining.

Apply insulation board to ceiling joists and wall studs, cutting in headers where ends of boards meet. If ceiling joists are spaced on centers greater than 16 inches, cross strip with 1 x 2 inch strips on 16 inch centers if ½ inch insulation board is to be used; 1 inch insulation board may be nailed on 24 inch centers. The extra cost of the thicker insulation board may not be as great as the labor and material required for stripping and applying ½ inch board.

Use standard ⅜ inch head 2 inch galvanized nails for ½ inch insulation board and 8d common nails for 25/32 inch and 1 inch insulation board. First nail insulation board to intermediate framing members, then nail the edges. On intermediate framing members, space nails 6 inches apart. At all edges space nails 3 inches apart and ⅜ inch away from the edge. Drive nails until the heads are flush with the insulation board surface.

Insulation board may be covered with a spray or brush coat of aluminum paint without priming. Where oil or varnish paints are to be used, insulation board must be properly sized before application of such paints. A satisfactory oil base size may be obtained from any of the leading paint manufacturers. Paint all joints before applying battens.

If cows face out, no protection of the insulation board surface is needed on feed alley wall. If cows face in, the litter alley wall should be protected with a wainscoting of lumber to prevent damage by cows, tools and litter carrier.

Figure 2 shows various types of dairy barn wall construction involving the use of insulation board.

Hog Houses

Hogs must have adequate protection in cold weather to thrive and produce at maximum efficiency. Warm shelter will prevent fattening hogs from burning up feed that otherwise would be converted into tissue. Breeding sows should be comfortably housed to protect their health and to assure vitality and strength in their young. Warm, comfortable quarters are vital for the little pig farrowed in winter or early spring.

The right kind of hog house pays dividends. Warm, dry houses are not only important in making it possible to farrow in February and March, but they are largely responsible for raising more pigs from each litter. Hogs marketed in September, when prices are usually at the peak, are generally the most profitable; and only through early farrowing and proper feeding is it possible to have the animals ready for market at this time.

Like other animals, hogs give off a limited quantity of body heat and none should be wasted. When a stove is used to supply extra heat, insulation board helps maintain safe, even temperatures just as it does in dairy barns and brooder houses. Insulation board helps make hog houses dry and easy to ventilate because only in warm houses is adequate ventilation obtainable. And without good ventilation, farrowing houses cannot be kept dry.

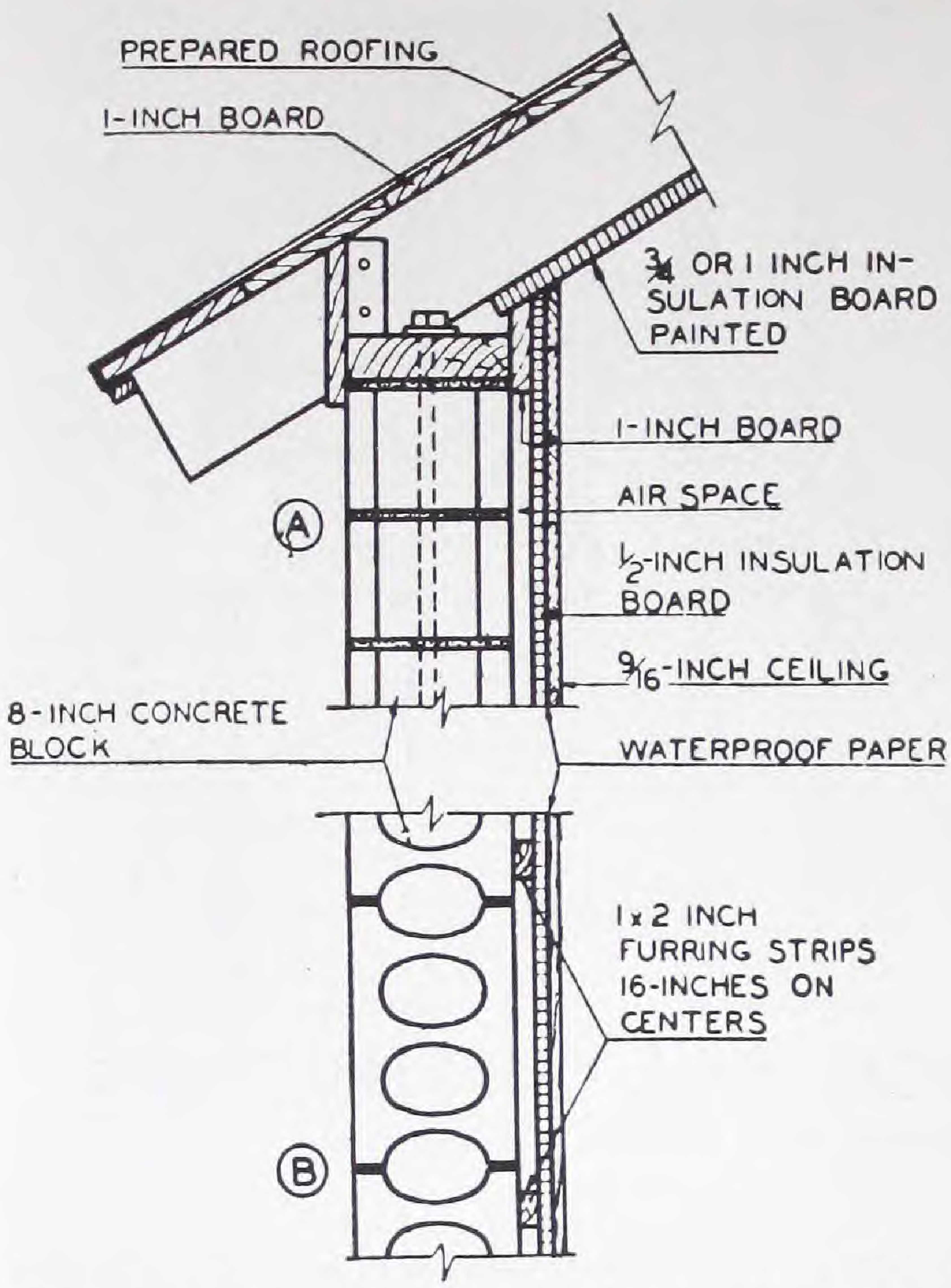


Figure 3. Insulated masonry hog-house construction. A is a vertical section through wall and roof; B is a horizontal section through wall.

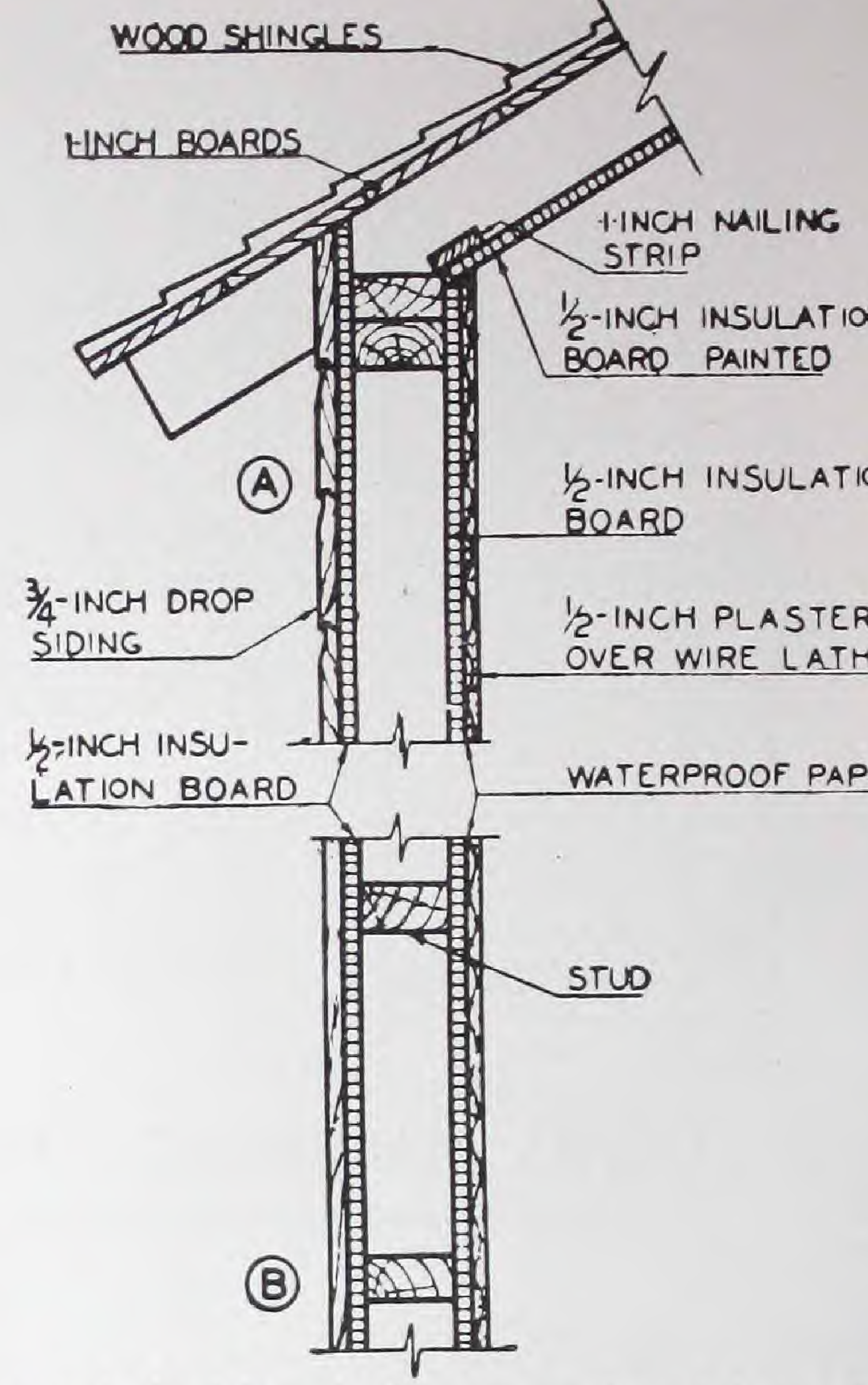


Figure 4. Insulated frame hog-house construction. A is a vertical section through wall and roof; B is a horizontal section through wall.

Construction of Insulated Hog Houses

In northern climates the exposed wall area of central hog houses should be reduced to the practical minimum. Low walls reduce the surface area through which heat escapes. Vertical and horizontal sections through masonry hog-house construction, showing the application of insulation board, are shown in Figure 3. Similar sections for frame construction are shown in Figure 4. The insulation requirements for hog-house construction of course vary with the climate. The insulation board thicknesses shown may be regarded as being proper for a hog house in Zones 1 and 2. Lesser thicknesses would suffice in Zones 3 and 4.

Individual portable hog houses meet the requirements of early farrowing. Such houses, when insulated, usually may be warmed to a comfortable temperature in even the coldest weather by animal heat alone. Insulation board is readily adapted to the construction of these types of houses. It is advisable to place the insulation on the outside of the studding and to cover it with siding or sheathing to protect it from the weather and the rough usage to which these houses are subjected.

Beehives

The importance of insulation of beehives is readily appreciated when the heat requirements of bees are recalled. Bees will not permit the temperature inside the hive to drop below 57 degrees F. When this temperature is reached they form a cluster and those in the center produce heat by muscular activity, while those on the outside of the sphere act as insulation to retain the heat. The colder the temperature outside, the more active the bees and the more food consumed. Not only is this uneconomical, but if the stores contain a high percentage of indigestible matter, a vicious cycle is started with an accumulation of feces causing increased activity and finally death from exhaustion. When wintering bees outdoors, therefore, insulation for the hive is of utmost importance in conserving the heat generated, thereby reducing activity and preserving the life of the colony.

Figure 5 shows a packing case constructed of insulation board. In this instance each hive has its own case, but it would be entirely feasible to group two or more colonies together and enclose the group in one case. Variations of this design have been used in which the panels of insulation are merely held in place by string until wrapped with heavy waterproof paper. Figure 6 shows a method of insulating permanently a hive with rigid insulation. It is important that the bottom, as well as sides, ends, and top of hive be insulated.

Fruit and Vegetable Storages

Fruits and vegetables are living organisms. In order to keep them alive for long periods, certain conditions of temperature and moisture are most desirable.

In general, there are two types of storages, namely, (1) common or air-cooled, and (2) refrigerated. In the first, only cool outside air is used for lowering the building temperature, whereas, in the second, either ice or mechanical refrigeration is employed. Where outdoor temperatures during the storage period are low enough, the common storage is most widely used because it is less expensive. In warm climates, on the other hand, refrig-

erated storage permits positive control over the temperature in both summer and winter and is therefore preferable to common storage. Artificial cooling is employed in the North also, but generally such storages are for commercial purposes and are not used on farms.

Since temperature control is one of the most important factors in fruit and vegetable storage, the success of the aboveground house depends largely on its insulation. Insulation conserves the heat given off by the stored products and thereby makes it possible to maintain proper temperatures in many cases without artificial heat. Furthermore, it prevents sudden changes in temperature, despite outside variations. Of course, sustained outdoor temperatures, whether hot or cold, will ultimately change the inside temperature, but insulation makes the change gradual from one temperature to another.

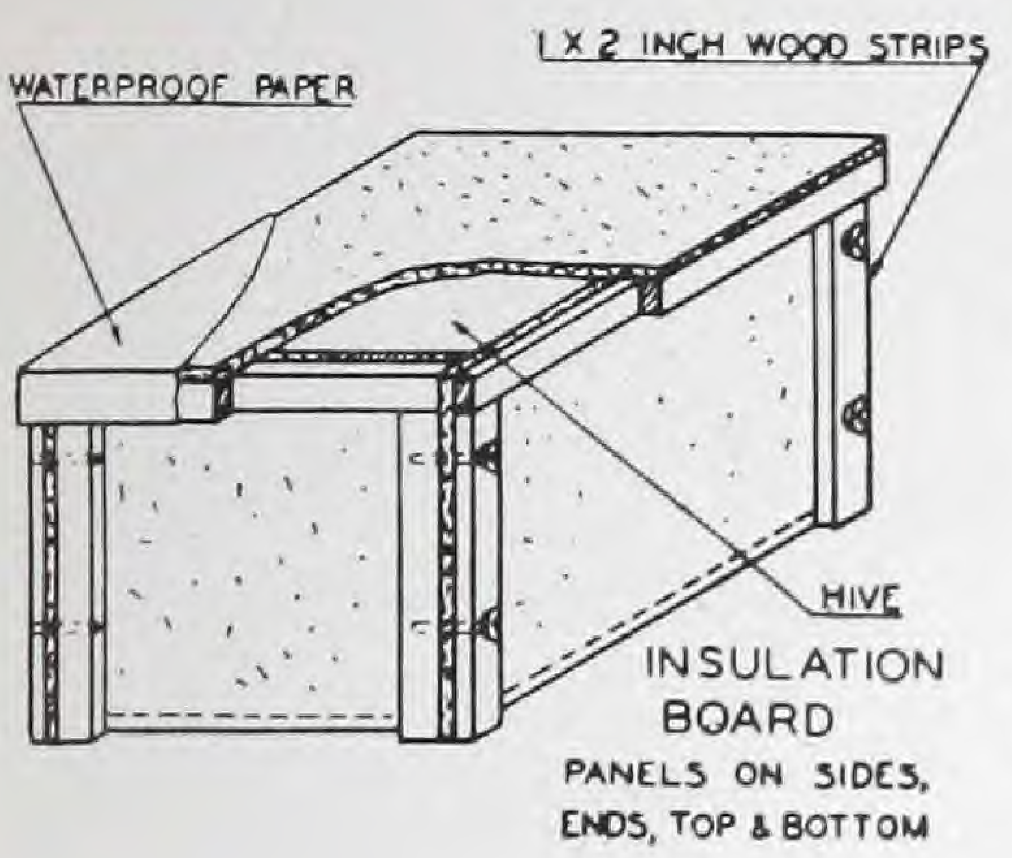


Figure 5. Hive insulated with detachable panels, insulation board on sides, ends and bottom. The 1 inch thickness is preferable.

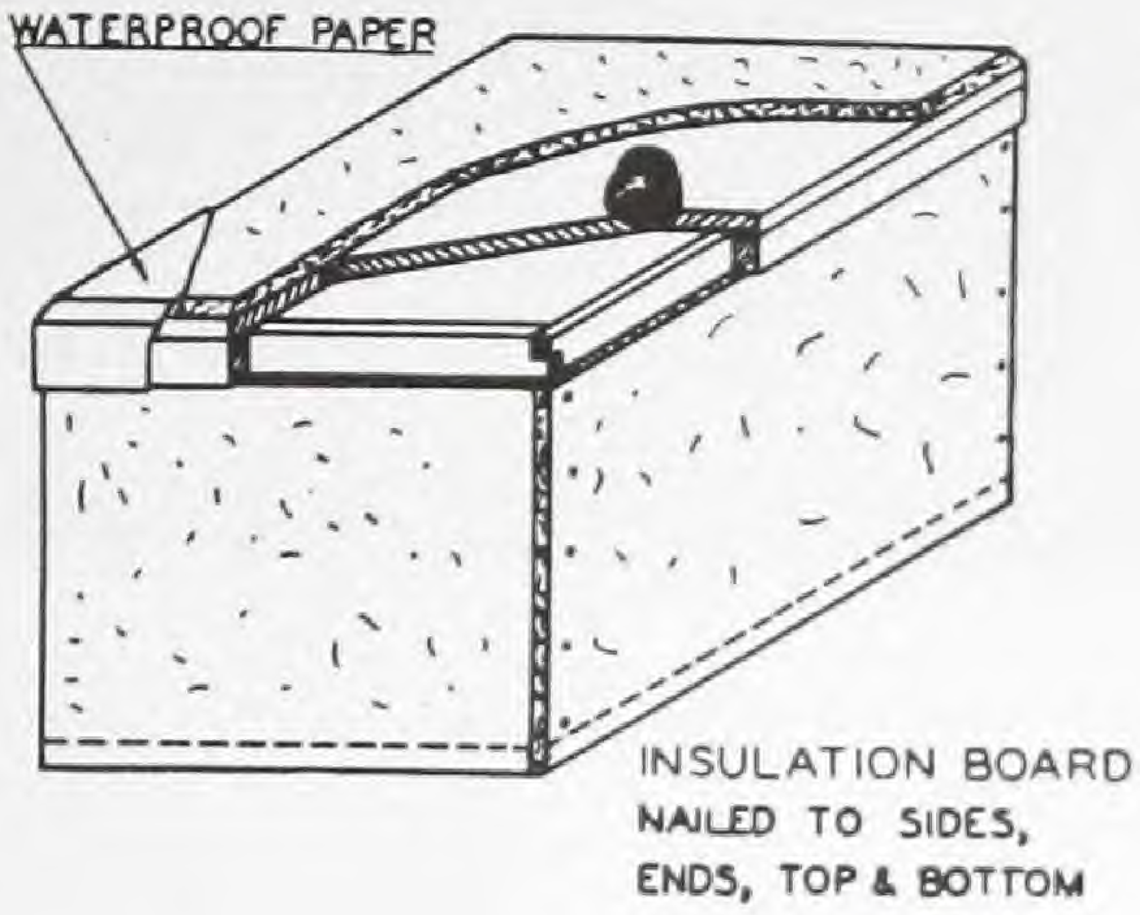


Figure 6. Permanently insulated hive. Insulation board nailed to sides, ends, top and bottom. The 1 inch thickness is preferable.

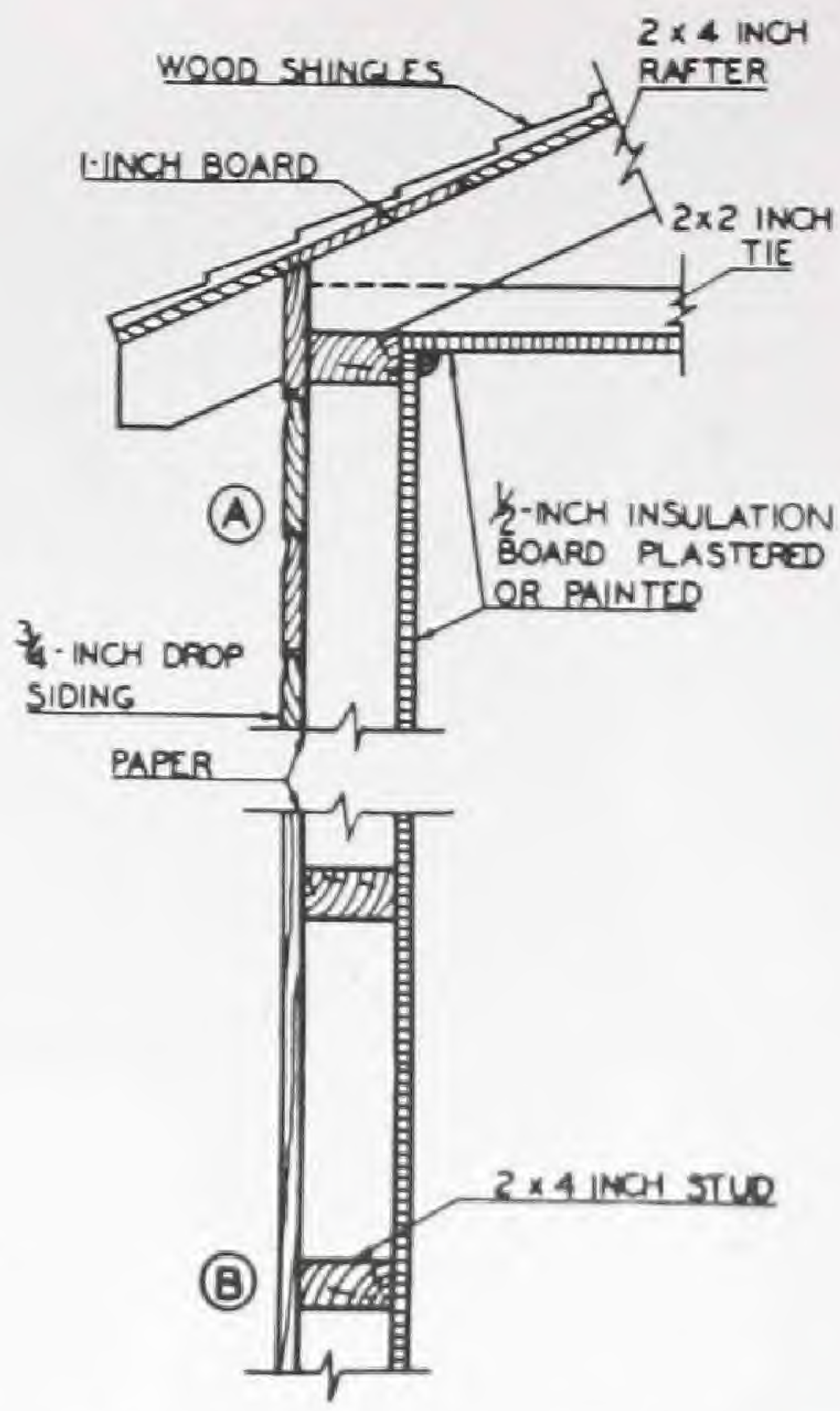
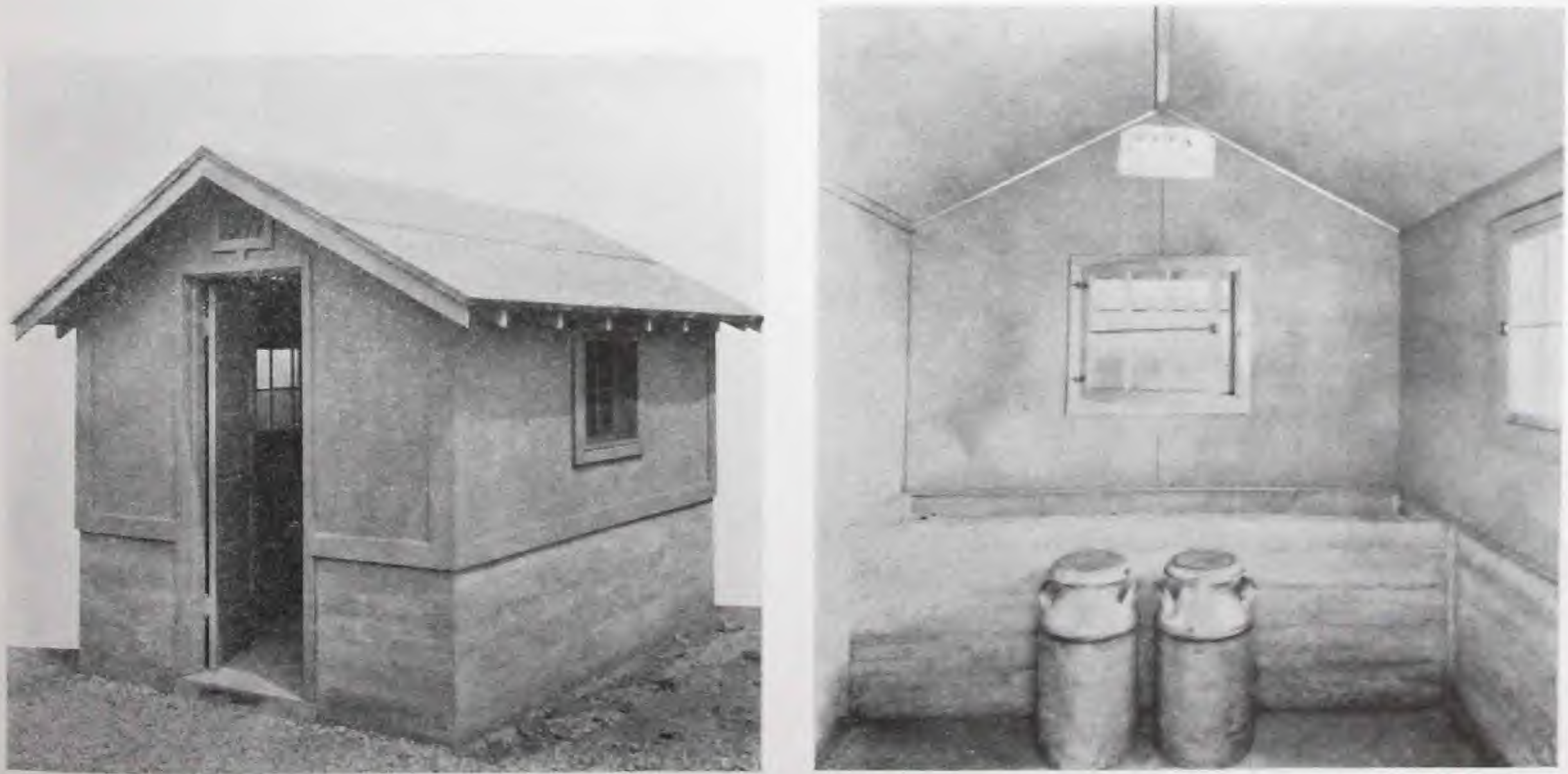


Figure 7. Insulated milk house construction. A is a vertical section through wall, roof and ceiling; B is a horizontal section through wall.

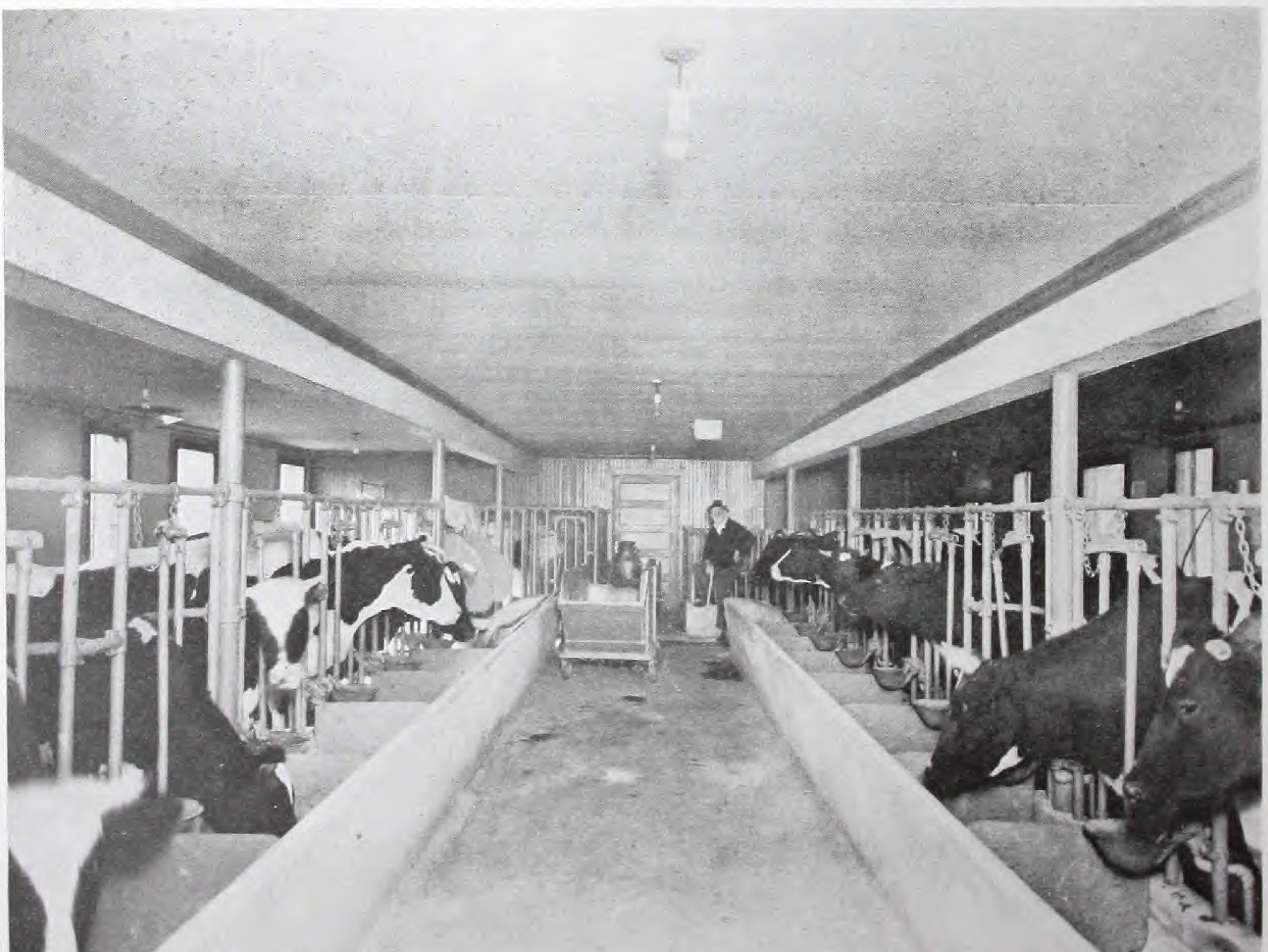
Most insulation board manufacturers supply plans and details for constructing fruit and vegetable storages and also submit recommendations as to the thicknesses required.

To the dairyman, the milk house has become as important as the barn itself, particularly since regulations for cooling and holding milk are stricter than ever before.

A typical wall construction using rigid insulation is shown in Figure 7. Precautions should always be taken to protect the insulation against moisture, since the air in the house is usually extremely moist. Painting the exposed surface of the insulation board serves this purpose and also promotes sanitation. Joints between boards should be covered with wood or metal batten nailed tightly and sealed with paint to prevent moisture from reaching hidden surfaces. Insulation board may also be used to insulate milk cooling tanks.



SMALL MILK HOUSE containing 400 feet of insulation board on walls and ceiling. This is one of the popular and profitable uses on the dairy and stock farm for insulation board.



COUNTY INFIRMARY dairy barn, Evansville, Ind., is a good example of the use of insulation board for stable ceilings; makes a clean, sanitary finish and assists in air conditioning.

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